E82 10187
CR- 168615

"STRUCTURE, COMPOSITION AND THERMAL STATE OF THE CRUST IN BRAZIL"

Investigation M-51

Igor Ivory Gil Pacca

Wladimir Shukowsky

Instituto Astronômico e Geofísico/USP - Brazil

Progress Report

FEB 1981 - MAY 1981

(E82-10187) STRUCTURE, COMPOSITION AND THERMAL STATE OF THE CRUST IN BRAZIL Progress Report, Feb. - May 1981 (Sao Paulo Univ.) 41 p HC A03/MF A01 CSCL 08G

N82-22621

Unclas
G3/43 00187

TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

This investigation aims at understanding the deep structure of the continental crust in Brazil and its variation in different structural environments. It is expected that a preliminary crustal model for the main structural provinces will be obtained. A secondary objective of this investigation is to check the normal geomagnetic field for the Brazilian area.

During the period covered by this report our activities were concentrated on the following topics:

i) Development and test of software to convert Magsat data tapes to a form readable by our computer.

ii) Assessment of the contents of the first Investigator B test tapes.

iii) Definition of our future activities in view of a preliminary analysis of the first total intensity anomaly map received from GSFC.

iv) Collection and organization of correlative data.

In the following sections the topics listed above will be discussed in greater detail.

DATA CONVERSION

All data tapes we receive must be converted from the original IBM/360 binary format to the Burroughs/B-6700 binary format. This is done in a two step operation. First a general Algol program was written which contains the code necessary to handle the conversion of the IBM variables of types R*4, I*4, I*2, L*1, A*4 and also two peculiar forms of integer variables found on

The Algol source program is the input to a FORTRAN program together with the description of the format of the records to be converted. The output of the FORTRAN program is an edited version of the Algol source tailored to the specific tape to be converted.

This two step procedure produces a very efficient code and is also very flexible, permiting to handle both the Investigator B and Chronicle tapes, as well as any unexpected format alterations, as for instance the Investigator B header record change in effect since March 5 1981.

Prior to be put to use, the data conversion software was subjected to intensive testing in order to identify and correct possible programming errors.

The listings of both the Algol source and the Fortran editor are given in the Appendix A.

DATA ASSESSMENT

Two programs, LISTER1 and LISTER2, were written to provide formatted listings of the Investigator B tapes.

Both programs read the (converted) Investigator B tape through the subroutine RDINVB. This routine performs all the I/O operations and also handles exceptional situations like end-of-file and I/O errors. The program LISTER1 produces an abridged listing of an Investigator B tape. From each header record only the Julian date, the pass number, the longitude of the nodes and the planetary activity index are printed. From each subsequent data record only the Julian date and time of the first data point are printed along with the pass number, the geographic coordinates and the anomalies AB, AX, AY, AZ computed

This kind of listing is useful to verify the coverage of the data as well as the geographic selection and K_p index screening of the data made by GSFC.

The program LISTER2 produces an almost complete listing of an Investigator B tape. The header records are printed in full, except for the coefficients of the internal field model which are not printed. The contents of the data records are completely printed out with the adition of the anomalies ΔB, ΔX, ΔY, ΔZ which are computed, printed and printer-plotted.

The listings of the two programs along with samples of the output are given in Appendix A.

By examining the listings produced by the program LISTER2 some inconsistencies were found on the first two INVB test tapes. At first it was suspected that the data conversion software was in error, but these inconsistencies were traced back to the original binary tapes received from GSFC. It was found that the components XMD and ZMD, computed from the spherical harmonic model coefficients,had the sign sistematically reversed with respect to the observed values for these components. Furthermore it was found that the field QUAL (attitude quality flag) specified as an I*4 value in the description of the INVB format, was in fact an I*2 value left justified in a 4 byte field.

PRELIMINARY ANALYSIS OF THE GSFC GLOBAL ANOMALY MAPS

A new version of an initial anomaly map, distributed to the investigators during the meeting at GSFC on December 4,5 1980, was received at the begining of May, 1981.

As GSFC distributed only the map but not the gridded anomaly values used to plot it, we were restricted to a visual analysis only.

The anomaly pattern in the region of South America is peculiar in two aspects. First, it is devoid of intense anomalies as compared for instance to the North American continent and to Australia. This is particularly visible in the colored version of the anomaly map. Secondly, the existing anomalies are weakly correlated with the main tectonic units of the Brazilian territory (DNPM, 1971b) except for the Amazon basin, which stands out as a prominent high with its maximum running along the basin.

Consi ering that the potential resolution of the Magsat data is certainly better than 2^{o}, as evidenced by the examination of the anomaly profiles of individual passes, we feel inclined to apply the equivalent source technique to the data. We hope that the cost in terms of computer time will be justified if the crustal magnetization parameters show such a high correlation with the tectonic pattern as was reported by Mayhew et al. (1980) for the POGO data.

CORRELATIVE DATA

A description of the correlative data we intend to use in the analysis of Magsat data, and which is adequatelly organized at present, is given below.

i) Geological data

The geological and tectonic maps of Brazil at the scale of 1:5,000,000 are available (DNPM, 1971a, 1971b).

ii) High resolution aeromagnetic data

An aeromagnetic survey covering the region limited by the parallels 14^{o}S and 23^{o}S and the meridians 39^{o}W and 38^{o}W was digitized from maps at the scale of 1:100,000. The digitization was made on a regular $0,1^{o} \times 0,1^{o}$ grid.

Maps of the measured field intensity and of the total intensity anomaly, plotted from the digitized data, are shown respectively on figures 1 and 2.

iii) High resolution gravity data

A gravity survey covering an area delimited by the parallels $18^{o}S$ and $20^{o}S$ and the meridians $41,5^{o}W$ and $50^{o}W$ is available.

The Bouguer map of the western part of this survey, which overlaps the area covered by the aeromagnetic survey previously described, is given in the paper of Blitzkow et al. (1980). The Appendix B contains a copy of this paper.

iv) Low resolution gravity data

There are two sources of low resolution gravity information we intend to use. One of them is the gravity anomalies derived from satellite geopotential models like GEM-9 and GEM-10 (Lerch et al., 1977). The other source is the set of terrestrial measurements averaged over $5^{o} \times 5^{o}$ blocks (Gaposhkin, 1979).

PROBLEMS

We have been experiencing difficulties with the customs clearance of some of the postal parcels containing Magsat Data tapes.

We referred the problem to Mr. Locke Stuart, and he suggested that we should try to receive the Magsat data by diplomatic pouch through the Brazilian embassy in Washington D.C.. Unfortunatelly we cannot use the diplomatic service for this purpose.

According to the customs authorithy, the problem is that

involved, and this value is not clearly specified for the Magsat data parcels. In order to correct the problem, all parcels should be accompanied by either an invoice of zero monetary value or a statement issued by the sender declaring the contents of the parcel to be scientific material with no commercial value.

REFERENCES

BLITZKOW, D.; GASPARINI, P.; SÁ, N.C.; MANTOVANI, M.S.M. - "Crustal Structure of Southeastern Minas Gerais, Brazil, Deduced from Gravity Measurements". Revista Brasileira de Geociências, 9(1979), 39-43.

MAYHEW, M.A.; JOHNSON, B.D.; LANGEL, R.A. - "Magnetic Anomalies at Satellite Elevation over Australia". NASA Technical Memorandum 80664, 1980.

DNPM - Departamento Nacional de Produção Mineral; Ministério das Minas e Energia - "Mapa Geológico do Brasil" (Geological Map of Brazil) 1971(a).

DNPM - "Mapa Tectônico do Brasil" (Tectonic Map of Brazil) 1971(b).

GAPOSCHKIN, E.M. - "Estimation of 550 km x 550 km Mean Gravity Anomalies and Mean Geoid Heights". Smithsonian Astrophysical Observatory, Special Report 384, 1979.

LERCH, F.J.; KLOSKO, S.M.; LAUBSCHER, R.E.; WAGNER, C.A. - "Gravity Model Improvement Using GEOS-3 (GEM-9 & GEM-10)". Goddard Space Flight Center Document X-921-77-246, 1977.

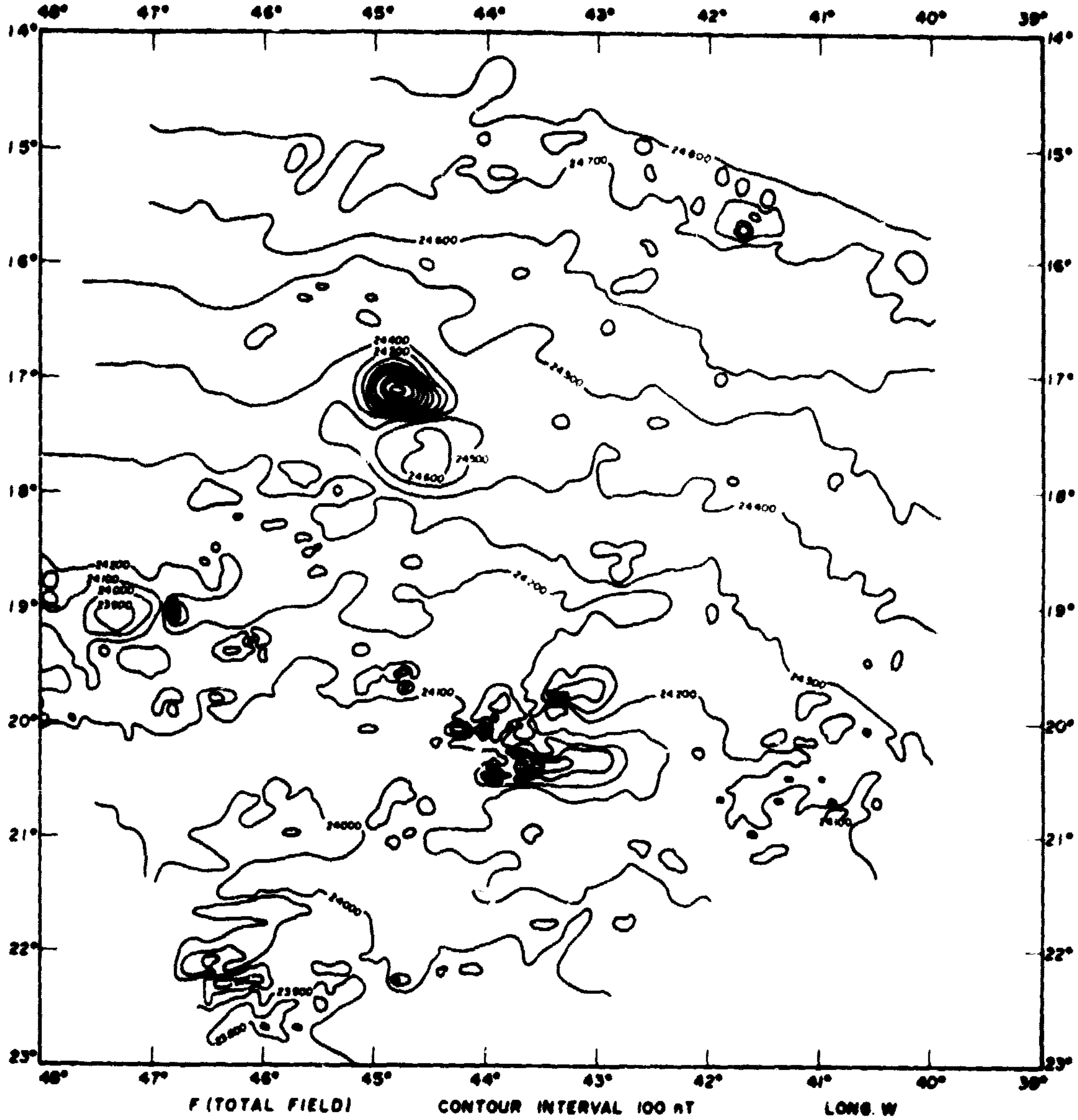


FIGURE 1. Total field intensity over the state of Minas Gerais, Brazil. The contour interval is 100 nT.

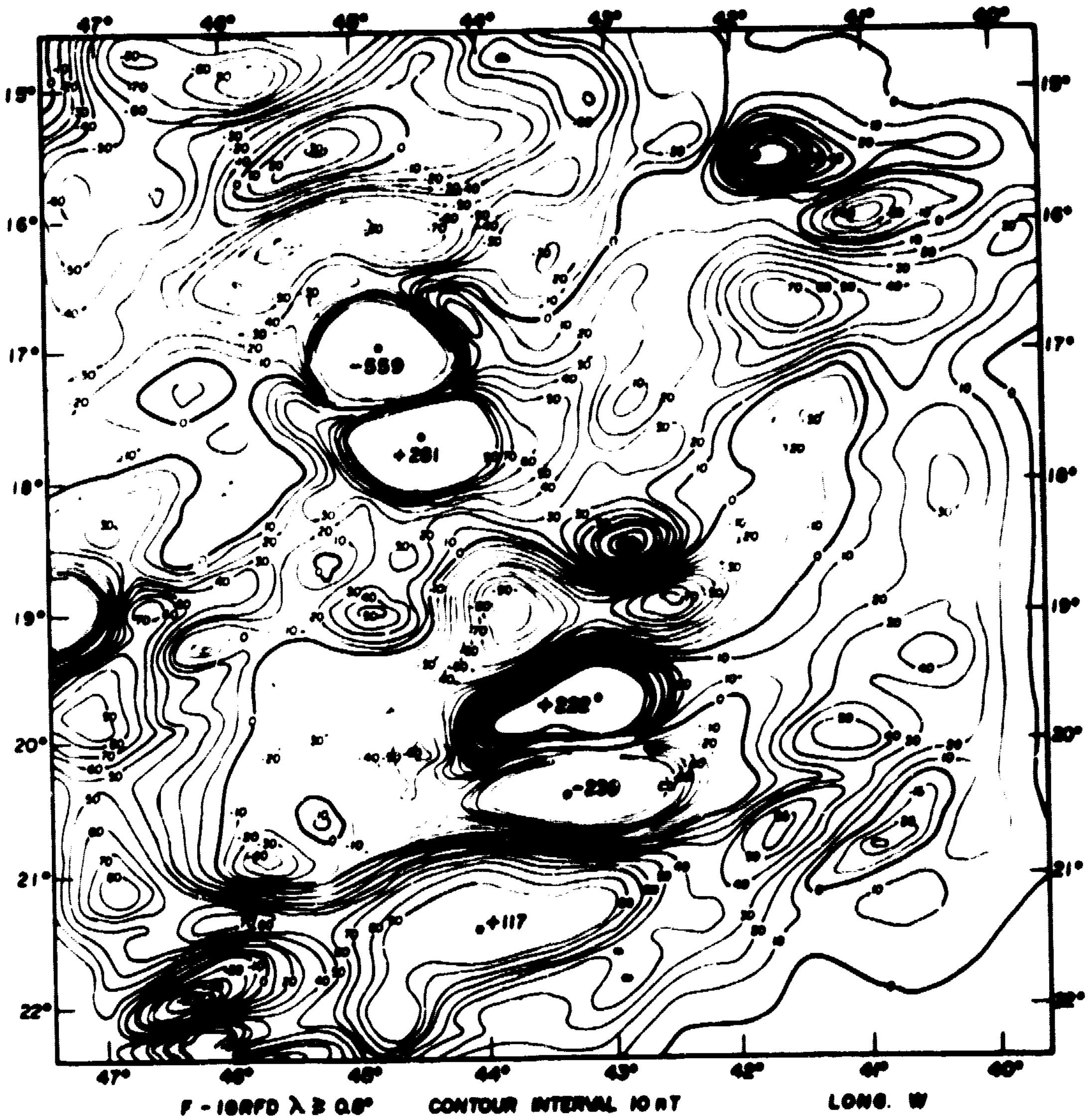


FIGURE 2. Total intensity anomaly over the state of Minas Gerais, Brazil. The contour interval is 10 nT.

APPENDIX A - PROGRAM LISTINGS

```
                                D U M M Y
                                = = = = =

                NEW SYMBOLIC:  (112AGG)PRIMARYSOURCE ON PACK.

$LABEL01                                                            00001000  A00:000010
BEGIN                                                               00002000  000:C00010
                                                                 B.0000 IS SEGMENT 00003
  FILE IN(KIND=TAPE,UNITS=CHARACTERS,LABELTYPE=OMITTEDEOF,       1  00003000  003:C00011
     MAXRECSIZE=3024,BLOCKSIZE=3024);                               00004000  003:C00011
                                                                       DATA IS 0007 LONG
 FILE OUT(KIND=TAPE,MAXRECSIZE=757,BLOCKSIZE=757)  ;                00005000  003:000011
                                                                       DATA IS 0C06 LONG
  FILE PRNT(KIND=PRINTER,MAXRECSIZE=22);                            00006000  003:000011
                                                                       DATA IS 0C05 LONG
     POINTER PIN;                                                   00007000  003:000011
     INTEGER KONT,J;                                                00008000  003:C00011
     REAL WORD,MSHIFT,EP,EG;                                        00009000  003:C00011
     LABEL HEADER,DATA,EOF,PAR,NEXT,DONE;                           00010000  003:000011
     LONG REAL ARRAY IB=IN[0:503],BOUT[0:756];                      00011000  003:000011
NEXT: READ(IN,3024,PIN:=POINTER(IBMIN))[EOF:PAR];                   00012000  003:C00011
     BOUT[0]:=KONT:=*+1;J:=1; %IF KONT GTR 20  THEN GO EOF;         00013000  003:C00610
     BOUT[1]:=REAL(PIN,4);PIN:=*+4;                                 00014000  003:C00015
     CASE BOUT[1]-1 OF                                              00015000  003:C01112
     BEGIN                                                          00016000  003:C01211
$LABEL02                                                         2  00017000  003:C01211
     END;                                                           00018000  003:C01211
     WRITE(OUT,757,BOUT);GO TO NEXT;                             2  00019000  003:C01413
PAR:  KONT:=*+1;WRITE(PRNT[SPACE 1],<"PAR ERR ON REC",I6>,KONT);    00020000  003:C01A15
     BOUT[0]:=KONT;BOUT[1]:=255;WRITE(OUT,757,BOUT);GO TO NEXT;     00021000  003:C02312
EOF:  WRITE(PRNT[SPACE 3],<I6," RECORDS PROCESSED">,KONT);LOCK(OUT);  00022000  003:C02C15
$LABEL03                                                            00023000  003:C03515
COMMENT   ...R*4...;                                                00024000  003:C03515
IF WORD:=REAL(PIN,4) EQL 0                                          00025000  003:003515
THEN BOUT[J:=*+1]:=0                                                00026000  003:003712
ELSE                                                                00027000  003:003915
  BEGIN                                                             00028000  003:C03A12
    IF(EP:=WORD.[30:7]-64) GTR 0                                 2  00029000  003:C03A15
    THEN  IF EP EQL 0                                               00030000  003:C03C14
          THEN BEGIN MSHIFT:=0;EG:=-13;END                          00031000  003:003D15
          ELSE BEGIN MSHIFT:=3-EP MOD 3;EG:=EP+EP DIV 3 - 12;END  3  00032000  003:004012
    ELSE  BEGIN MSHIFT:=-EP MOD 3;EG:=EP+EP DIV 3-13;END;        3  00033000  003:004415
  IF EG.[39:39] LSS 6;                                           3  00034000  003:004910
  THEN BOUT[J:=*+1]:=0&WORD[46:31:1]&EG[45:46:1]&EG[44:5:6]         00035000  003:C04915
                                    &WORD[38-MSHIFT:23:24]          00036000  003:C04F11
  ELSE IF EG.[46:1] EQL 0                                           00037000  003:C05110
       THEN BOUT[J:=*+1]:=4"1FFFFFFFFFFF"&WORD[46:31:1]             00038000  003:005312
       ELSE BOUT[J:=*+1]:=4"3F9000000000"&WORD[46:31:1];            00039000  003:005712
  END;                                                              00040000  003:005C14
  PIN:=*+4;                                                      2  00041000  003:005C04
$LABEL04                                                            00042000  003:005E12
COMMENT   ...A*8...;                                                00043000  003:C05E12
     BOUT[J:=*+1]:=4"404040404040"&REAL(PIN,4)[47:31:32];PIN:=*+4;  00044000  003:005E12
$LABEL05                                                            00045000  003:006512
```

ORIGINAL PAGE IS
OF POOR QUALITY

```
COMMENT    ...L=1...;                                                00046000  003:0065:2
        BOUT[J:=*+1]:=REAL(PIN,1);PIN:=*+1;                          00047000  003:0065:2
$LABEL06                                                             00048000  003:0069:4
COMMENT    ...I=4...;                                                00049000  003:0069:4
        WORD:=REAL(PIN,4);                                           00050000  003:0069:4
        BOUT[J:=*+1]:=IF BOOLEAN(WORD.[31:1]) THEN -(4"80000000"     00051000  003:006A:4
                     -WORD.[30:31]) ELSE WORD.[30:31];               00052000  003:006D:5
        PIN:=*+4;                                                    00053000  003:0071:0
$LABEL07                                                             00054000  003:0072:4
COMMENT    ...I=2...;                                                00055000  003:0072:4
        WORD:=REAL(PIN,2);                                           00056000  003:0072:4
        BOUT[J:=*+1]:=IF BOOLEAN(WORD.[15:1]) THEN -(4"8000"-WORD.[14:15]   00057000  003:0073:4
                                          ) ELSE WORD.[14:15];       00058000  003:0077:4
        PIN:=*+2;                                                    00059000  003:007A:0
$LABEL08                                                             00060000  003:007B:4
COMMENT    ...IA...                                                  00061000  003:007B:4
              THIS IS A SPECIAL CASE                                 00062000  003:007B:4
              CORRESPONDING TO                                       00063000  003:007B:4
                   I2&X2;                                            00064000  003:007B:4
        WORD:=REAL(PIN,2);                                           00065000  003:007B:4
        BOUT[J:=*+1]:= IF BOOLEAN(WORD.[15:1])                       00066000  003:007C:4
                           THEN -(4"8000"-WORD.[14:15])              00067000  003:007E:5
                           ELSE WORD.[14:15];                        00068000  003:0080:4
        PIN:=*+4;                                                    00069000  003:0083:0
$LABEL09                                                             00070000  003:0084:4
COMMENT    ...IB...                                                  00071000  003:0084:4
              THIS IS A SPECIAL CASE                                 00072000  003:0084:4
                CORRESPONDING TO                                     00073000  003:0084:4
                 X2&I2;                                              00074000  003:0084:4
        PIN:=*+2;                                                    00075000  003:0084:4
        WORD:=REAL(PIN,2);                                           00076000  003:0085:5
        BOUT[J:=*+1]:=IF BOOLEAN(WORD.[15:1])                        00077000  003:0086:5
                         THEN -(4"8000"-WORD.[14:15])                00078000  003:0089:0
                         ELSE WORD.[14:15];                          00079000  003:008A:5
        PIN:=*+2;                                                    00080000  003:008D:1
$LABEL10                                                             00081000  003:008E:5
$LABEL11                                                             00082000  003:008E:5
$LABEL12                                                             00083000  003:008E:5
$LABEL99                                                             00084000  003:008E:5
END OF PROGRAM.                                                      00085000  003:008E:5
                                                              B.0000(003) IS 00A2 LONG
                                                                     DATA IS 000E LONG
=======================================================================================
ER OF ERRORS DETECTED = 0.
ER OF SEGMENTS = 3.  TOTAL SEGMENT SIZE = 194 WORDS.  CORE ESTIMATE = 4007 WORDS.  STACK ESTIMATE = 17
RAM SIZE = 85 CARDS, 601 SYNTACTIC ITEMS, 18 DISK SEGMENTS.
RAM FILE NAME:  DUMMY.
ILATION TIME = 11.160 SECONDS ELAPSED;  1.785 SECONDS PROCESSING;  0.687 SECONDS I/O.
=======================================================================================
```

A L G O L E D I T O R

```
C***************************************************************** ********   C  000:0000:5
C                                                                             C  000:0000:5
C    >>>ALGOLEDITOR/VERSION 01<<<                                             C  000:0000:5
C                                                                             C  000:0000:5
C*************<*************************************************** ********   C  000:0000:5
                                                                              START OF SEGMENT 002
      DIMENSION BUF(14),LBL(100),SPEC(20),IREPT(12),TYPE(12)                  C  002:0000:0
      LOGICAL NCASE/.TRUE./                                                   C  002:0000:0
      DATA SPEC/"R4    ","A4    ","L1    ","I4    ","I2    ","IA    ",        C  002:0000:0
     -  "IB    "/                                                             C  002:0000:0
              *
WARNING:TOO FEW CONSTANTS IN DATA PART - THE NUMBER OF ELEMENTS OF "SPEC" BLANKED = 13       (260)

C                                                                             C  002:0000:0
C    LOCATE MARKERS                                                           C  002:0000:0
C                                                                             C  002:0000:0
      IP=0                                                                    C  002:0000:0
200   IP=IP+1                                                                 C  002:0000:4
      READ(9,END=999)BUF                                                      C  002:0002:0
                                                                                  FIB IS 0006 LONG
      IF(BUF(1).NE."$LABEL")GO TO 200                                         C  002:0007:0
      READ(BUF,900)K                                                          C  002:0009:4
900   FORMAT(6X,I2)                                                           C  002:0011:2
      LBL(K)=IP                                                               C  002:0011:2
      GO TO 200                                                               C  002:0013:0
999   REWIND 9                                                                C  002:0013:3
C                                                                             C  002:0015:0
C    INITIAL FIXED PART                                                       C  002:0015:0
C                                                                             C  002:0015:0
      IP=0;CALL INCLDE(IP,LBL(1),LBL(2))                                      C  002:0015:0
C                                                                             C  002:0018:3
C    GENERATE CASES                                                           C  002:0018:3
C                                                                             C  002:0018:3
201   READ(5,500,END=555)(IREPT(I),TYPE(I),I=1,12)                            C  002:0018:3
                                                                                  FIB IS 0006 LONG
500   FORMAT(12(I4,A2))                                                       C  002:0029:0
      WRITE(6,610)(IREPT(I),TYPE(I),I=1,12)                                   C  002:0029:0
                                                                                  FIB IS 0006 LONG
610   FORMAT("0ALGOLEDITOR FORMAT(",12(I4,A2),")")                            C  002:0037:2
      IF(NCASE)GO TO 202                                                      C  002:0037:2
205   DO 100 I=1,12                                                           C  002:003E:1
      IF(IREPT(I).EQ.0)GO TO 203                                              C  002:0039:0
      AUX=TYPE(I)                                                             C  002:003A:5
      DO 101 J=1,20                                                           C  002:003C:2
      IF(AUX.EQ.SPEC(J))GO TO 204                                             C  002:003D:0
101   CONTINUE                                                                C  002:003F:0
      WRITE(6,600)AUX                                                         C  002:0041:1
600   FORMAT(1X,"***ALGOLEDITOR***INVALID TYPE ",A6)                          C  002:0048:2
      STOP                                                                    C  002:0048:2
204   K=J+2                                                                   C  002:0049:1
      IP=IP+1;WRITE(8,801)IREPT(I)                                            C  002:004A:4
                                                                                  FIB IS 0006 LONG
801   FORMAT("           THRU ",I4," DO BEGIN")                               C  002:0053:2
      CALL INCLDE(IP,LBL(K),LBL(K+1))                                         C  002:0053:2
      IP=IP+1                                                                 C  002:0056:5
```

```
      WRITE(8,802)                                                      C  002:0058:1
602   FORMAT("                                   END;")                 C  002:005C:2
100   CONTINUE                                                          C  002:005C:2
202   IP=IP+1;WRITE(8,803)                                              C  002:005E:3
803   FORMAT("            BEGIN")                                       C  002:0064:2
      NCASE=.FALSE.                                                     C  002:0064:2
      GO TO 205                                                         C  002:0065:0
203   WRITE(8,802);IP=IP+1                                              C  002:0065:3
      NCASE=.TRUE.;GO TO 201                                            C  002:006A:4
555   CALL INCLDE(IP,LBL(2),LBL(3));CALL INCLDE(IP,LBL(99),0)           C  002:006B:5
      LOCK 8;STOP                                                       C  002:0071:1
      END                                                               C  002:0073:3
      002:0076:5  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 002:0018
      002:007A:0  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 002:0002
                                                                      SEGMENT 002 IS 008C LONG

==========================================================================================

                                                                      START OF SEGMENT 005
      SUBROUTINE INCLDE(IP,ML,MU)                                       C  005:0000:0
      DIMENSION BUF(14)                                                 C  005:0000:0
      KL=ML+1;KU=MU-1                                                   C  005:0000:0
      IF(MU.EQ.0)KU=KL                                                  C  005:0002:4
      IF(KU.LT.KL)RETURN                                                C  005:0004:4
      DO 100 K=KL,KU                                                    C  005:0006:0
      IP=IP+1                                                           C  005:0007:0
      READ(9=K)BUF                                                      C  005:0008:2
100   WRITE(8=IP)BUF                                                    C  005:0013:0
      RETURN                                                            C  005:0020:1
      END                                                               C  005:0020:4
      005:002A:1  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 005:0013
      005:002B:3  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 005:0008
                                                                      SEGMENT 005 IS 002C LONG

==========================================================================================

                                                                      FORMAT SEGMENT IS 0039 LONG
                                                                         START OF SEGMENT 006
                                                                      SEGMENT 006 IS 001E LONG
      NO ERRORS DETECTED.  NUMBER OF CARDS = 70.
      COMPILATION TIME = 1* SECONDS ELAPSED,  1.64 SECONDS PROCESSING.
      D2 STACK SIZE = 16 WORDS.  FILESIZE = 296 WORDS.  ESTIMATED CORE STORAGE REQUIREMENT = 758 WORDS.
      TOTAL PROGRAM CODE = 259 WORDS.  ARRAY STORAGE = 172 WORDS.
      NUMBER OF PROGRAM SEGMENTS = 6.  NUMBER OF DISK SEGMENTS = 27.
      PROGRAM CODE FILE = (112AGG)ALGOLEDITOR ON PACK.
      COMPILER COMPILED ON 09/07/79 (FORTRAN ON PACK).
```

```
ALGOLEDITOR FORMAT(   3I4   4R4   2I4   4R4   2I4  18R4  30A4   3I4 490R4   0    0    0 )
ALGOLEDITOR FORMAT(   4I4 691R4  30I8  30A4    0    0    0    0    0    0    0    0 )
```

ORIGINAL PAGE IS
OF POOR QUALITY

```
                    I N V B / I B M T O B 6 7 0 0
                    = = = = = = = = = = = = = = = =

          SOURCE TAPE:   (112AGG)SOURCE/INVB/IBMTOB6700 ON PACK.

 $SET MERGE                                                              P            000:0000:0
BEGIN                                                                       00002000  000:0000:0
                                                                           8.0000 IS SEGMENT 00003
   FILE INX(KIND=TAPE,UNITS=CHARACTERS,LABELTYPE=OMITTEDEOF,             1  00003000  003:0000:1
      MAXRECSIZE=3024,BLOCKSIZE=3024);                                      00004000  003:0000:1
                                                                               DATA IS 0007 LONG
 FILE OUT(KIND=TAPE,MAXRECSIZE=757,BLOCKSIZE=757)  ;                        00005000  003:0000:1
                                                                               DATA IS 0006 LONG
   FILE PRNT(KIND=PRINTER,MAXRECSIZE=22);                                   00006000  003:0000:1
                                                                               DATA IS 0005 LONG
      POINTER PIN;                                                          00007000  003:0000:1
      INTEGER KONT,J;                                                       00008000  003:0000:1
      REAL WORD,MSHIFT,EP,EG;                                               00009000  003:0000:1
      LABEL HEADER,DATA,EOF,PAR,NEXT,DONE;                                  00010000  003:0000:1
      LONG REAL ARRAY IBMIN[0:503],BOUT[0:756];                             00011000  003:0000:1
NEXT: READ(INX,3024,PIN:=POINTER(IBMIN))[EOF:PAR];                          00012000  003:0000:1
      BOUT[0]:=KONT:=*+1;J:=1; %IF KONT GTR 20  THEN GO EOF;                00013000  003:000B:0
      BOUT[1]:=REAL(PIN,4);PIN:=*+4;                                        00014000  003:000C:5
      CASE BOUT[1]-1 OF                                                     00015000  003:0011:2
      BEGIN                                                                 00016000  003:0012:1
          BEGIN                                                          2            003:0012:1
          THRU    3 DO BEGIN                                             3            003:0014:3
COMMENT   ...I*4...;                                                     4  00049000  003:0017:4
      WORD:=REAL(PIN,4);                                                    00050000  003:0017:4
      BOUT[J:=*+1]:=IF BOOLEAN(WORD.[31:1]) THEN -(4"80000000"              00051000  003:0019:1
                    -WORD.[30:31]) ELSE WORD.[30:31];                       00052000  003:001C:2
      PIN:=*+4;                                                             00053000  003:001F:3
                                    END;                                              003:0021:1
          THRU    4 DO BEGIN                                             4            003:0023:1
COMMENT   ...R*4...;                                                     4  00024000  003:0026:2
IF WORD:=REAL(PIN,4) EQL 0                                                  00025000  003:0026:2
THEN BOUT[J:=*+1]:=0                                                        00026000  003:0027:5
ELSE                                                                        00027000  003:002A:2
  BEGIN                                                                     00028000  003:002A:5
    IF(EP:=WORD.[30:7]-64) GTR 0                                         5  00029000  003:002B:2
    THEN  IF EP EQL 0                                                       00030000  003:002D:1
          THEN BEGIN MSHIFT:=0;EG:=-13;END                                  00031000  003:002E:2
          ELSE BEGIN MSHIFT:=3-EP MOD 3;EG:=EP+EP DIV 3 - 12;END         6  00032000  003:0030:5
    ELSE  BEGIN MSHIFT:=-EP MOD 3;EG:=EP+EP DIV 3-13;END;                6  00033000  003:0035:2
  IF EG.[39:39] LSS 63                                                   6  00034000  003:0039:3
  THEN BOUT[J:=*+1]:=0&WORD[46:31:1]&EG[45:46:1]&EG[44:5:6]                 00035000  003:003A:2
                                   &WORD[38-MSHIFT:23:24]                   00036000  003:003F:4
  ELSE IF EG.[46:1] EQL 0                                                   00037000  003:0041:3
       THEN BOUT[J:=*+1]:=4"1FFFFFFFFFFF"&WORD[46:31:1]                     00038000  003:0043:5
       ELSE BOUT[J:=*+1]:=4"3F9000000000"&WORD[46:31:1];                    00039000  003:0048:2
  END;                                                                      00040000  003:004D:4
  PIN:=*+4;                                                              5  00041000  003:004D:4
                                    END;                                              003:004F:2
          THRU    2 DO BEGIN                                             4            003:0051:2
```

ORIGINAL PAGE IS
OF POOR QUALITY

```
CUMMENT    ...I*4...;                                              4   00049000  003:C054:3
      WORD:=REAL(PIN,4);                                                00050000  003:C054:3
      BOUT[J:=*+1]:=IF BOOLEAN(WORD.[31:1]) THEN -(4"80000000"         00051000  003:0056:0
                   -WORD.[30:31]) ELSE WORD.[30:31];                    00052000  003:C059:1
      PIN:=*+4;                                                         00053000  003:005C:2
                                    END;                                          003:C05E:0
          THRU     4 DO BEGIN                                      4             003:C060:0
CUMMENT    ...R*4...;                                              4   00024000  003:C063:1
IF WORD:=REAL(PIN,4) EQL 0                                              00025000  003:C063:1
THEN BOUT[J:=*+1]:=0                                                    00026000  003:0064:4
ELSE                                                                    00027000  003:C067:1
  BEGIN                                                                 00028000  003:C067:4
    IF(EP:=WORD.[30:7]-64) GTR 0                                   5   00029000  003:CC68:1
    THEN  IF EP EQL 0                                                   00030000  003:C06A:0
          THEN BEGIN MSHIFT:=0;EG:=-13;END                              00031000  003:C06B:1
          ELSE BEGIN MSHIFT:=3-EP MOD 3;EG:=EP+EP DIV 3 - 12;END   6   00032000  003:006D:4
    ELSE  BEGIN MSHIFT:=-EP MOD 3;EG:=EP+EP DIV 3-13;END;          6   00033000  003:C072:1
  IF EG.[39:39] LSS 63                                             6   00034000  003:0076:2
  THEN BOUT[J:=*+1]:=0&WORD[46:31:1]&EG[45:46:1]&EG[44:5:6]             00035000  003:C077:1
                                   &WORD[38-MSHIFT:23:24]               00036000  003:007C:3
  ELSE IF EG.[46:1] EQL 0                                               00037000  003:C07E:2
       THEN BOUT[J:=*+1]:=4"1FFFFFFFFFFF"&WORD[46:31:1]                 00038000  003:C080:4
       ELSE BOUT[J:=*+1]:=4"3F9000000000"&WORD[46:31:1];                00039000  003:C085:2
  END;                                                                  00040000  003:008A:4
  PIN:=*+4;                                                        5   00041000  003:008A:4
                                    END;                                          003:008C:2
          THRU     2 DO BEGIN                                      4             003:C08E:2
CUMMENT    ...I*4...;                                              4   00049000  003:C091:3
      WORD:=REAL(PIN,4);                                                00050000  003:C091:3
      BOUT[J:=*+1]:=IF BOOLEAN(WORD.[31:1]) THEN -(4"80000000"         00051000  003:C093:0
                   -WORD.[30:31]) ELSE WORD.[30:31];                    00052000  003:C096:1
      PIN:=*+4;                                                         00053000  003:C099:2
                                    END;                                          003:C09B:0
          THRU    18 DO BEGIN                                      4             003:C09D:0
CUMMENT    ...R*4...;                                              4   00024000  003:C0A0:1
IF WORD:=REAL(PIN,4) EQL 0                                              00025000  003:CCAC:1
THEN BOUT[J:=*+1]:=0                                                    00026000  003:C0A1:4
ELSE                                                                    00027000  003:C0A4:1
  BEGIN                                                                 00028000  003:C0A4:4
    IF(EP:=WORD.[30:7]-64) GTR 0                                   5   00029000  003:C0A5:1
    THEN  IF EP EQL 0                                                   00030000  003:00A7:0
          THEN BEGIN MSHIFT:=0;EG:=-13;END                              00031000  003:C0A8:1
          ELSE BEGIN MSHIFT:=3-EP MOD 3;EG:=EP+EP DIV 3 - 12;END   6   00032000  003:C0AA:4
    ELSE  BEGIN MSHIFT:=-EP MOD 3;EG:=EP+EP DIV 3-13;END;          6   00033000  003:C0AF:1
  IF EG.[39:39] LSS 63                                             6   00034000  003:00B3:2
  THEN BOUT[J:=*+1]:=0&WORD[46:31:1]&EG[45:46:1]&EG[44:5:6]             00035000  003:C0B4:1
                                   &WORD[38-MSHIFT:23:24]               00036000  003:C0B9:3
  ELSE IF EG.[46:1] EQL 0                                               00037000  003:00BB:2
       THEN BOUT[J:=*+1]:=4"1FFFFFFFFFFF"&WORD[46:31:1]                 00038000  003:CCBD:4
       ELSE BOUT[J:=*+1]:=4"3F9000000000"&WORD[46:31:1];                00039000  003:C0C2:2
  END;                                                                  00040000  003:00C7:4
  PIN:=*+4;                                                        5   00041000  003:CCC7:4
                                    END;                                          003:C0C9:2
          THRU    30 DO BEGIN                                      4             003:00CB:2
CUMMENT    ...A*4...;                                              4   00043000  003:C0CE:3
      BOUT[J:=*+1]:=4"404040404040"&REAL(PIN,4)[47:31:32];PIN:=*+4;     00044000  003:00CE:3
                                    END;                                          003:C0D5:2
          THRU     3 DO BEGIN                                      4             003:00D7:2
CUMMENT    ...I*4...;                                              4   00049000  003:00DA:3
      WORD:=REAL(PIN,4);                                                00050000  003:00DA:3
```

```
     BOUT[J:=*+1]:=IF BOOLEAN(WORD.[31:1]) THEN -(4"80000C00"
                     -WORD.[30:31]) ELSE WORD.[30:31];
      PIN:=*+4;
                                 END;
          THRU  490 DO BEGIN
COMMENT    ...R*4...;
IF WORD:=REAL(PIN,4) EQL 0
THEN BOUT[J:=*+1]:=0
ELSE
  BEGIN
    IF(EP:=WORD.[30:7]-64) GTR 0
    THEN  IF EP EQL 0
          THEN BEGIN MSHIFT:=0;EG:=-13;END
          ELSE BEGIN MSHIFT:=3-EP MOD 3;EG:=EP+EP DIV 3 - 12;END
    ELSE  BEGIN MSHIFT:=-EP MOD 3;EG:=EP+EP DIV 3-13;END;
  IF EG.[39:39] LSS 63
  THEN BOUT[J:=*+1]:=0&WORD[46:31:1]&EG[45:46:1]&EG[44:5:6]
                                  &WORD[38-MSHIFT:23:24]
  ELSE IF EG.[46:1] EQL 0
       THEN BOUT[J:=*+1]:=4"1FFFFFFFFFFF"&WORD[46:31:1]
       ELSE BOUT[J:=*+1]:=4"3F9000000000"&WORD[46:31:1];
  END;
  PIN:=*+4;
                                 END;
                                 END;
          BEGIN
          THRU     4 DO BEGIN
COMMENT    ...I*4...;
      WORD:=REAL(PIN,4);
      BOUT[J:=*+1]:=IF BOOLEAN(WORD.[31:1]) THEN -(4"80000000"
                     -WORD.[30:31]) ELSE WORD.[30:31];
      PIN:=*+4;
                                 END;
          THRU  691 DO BEGIN
COMMENT    ...R*4...;
IF WORD:=REAL(PIN,4) EQL 0
THEN BOUT[J:=*+1]:=0
ELSE
  BEGIN
    IF(EP:=WORD.[30:7]-64) GTR 0
    THEN  IF EP EQL 0
          THEN BEGIN MSHIFT:=0;EG:=-13;END
          ELSE BEGIN MSHIFT:=3-EP MOD 3;EG:=EP+EP DIV 3 - 12;END
    ELSE  BEGIN MSHIFT:=-EP MOD 3;EG:=EP+EP DIV 3-13;END;
  IF EG.[39:39] LSS 63
  THEN BOUT[J:=*+1]:=0&WORD[46:31:1]&EG[45:46:1]&EG[44:5:6]
                                  &WORD[38-MSHIFT:23:24]
  ELSE IF EG.[46:1] EQL 0
       THEN BOUT[J:=*+1]:=4"1FFFFFFFFFFF"&WORD[46:31:1]
       ELSE BOUT[J:=*+1]:=4"3F9000000000"&WORD[46:31:1];
  END;
  PIN:=*+4;
                                 END;
          THRU   30 DO BEGIN
COMMENT    ...IB...
              THIS IS A SPECIAL CASE
                CORRESPONDING TO
                 X2&I2;
      PIN:=*+2;
      WORD:=REAL(PIN,2);
```

ORIGINAL PAGE IS
OF POOR QUALITY

```
        BOUT[J:=*+1]:=IF BOOLEAN(WORD.[15:1])                                          00077000  003:0157:1
                              THEN -(4"8000"-WORD.[14:15])                             00078000  003:C159:2
                              ELSE WORD.[14:15];                                       00079000  003:015B:1
        PIN:=*+2;                                                                      00080000  003:015D:3
                                     END;                                                        003:C15F:1
            THRU    30 DO BEGIN .                                                    4           003:0161:1
    COMMENT    ...A*4...;                                                            4  00043000  003:0164:2
        BOUT[J:=*+1]:=4"404040404040"&REAL(PIN,4)[47:31:32];PIN:=*+4;                   00044000  003:0164:2
                                     END;                                                        003:0168:2
                                     END;                                            4           003:C16D:2
        END;                                                                         3  00018000  003:016C:5
        WRITE(OUT,757,BOUT);GO TO NEXT;                                              2  00019000  003:C16F:0
    PAR:  KONT:=*+1;WRITE(PRNT[SPACE 1],<"PAR ERR ON REC",I6>,KONT);                    00020000  003:0175:5
        BOUT[0]:=KONT;BOUT[1]:=256;WRITE(OUT,757,BOUT);GO TO NEXT;                      00021000  003:C17E:2
    EOF:  WRITE(PRNT[SPACE 3],<I6," RECORDS PROCESSED">,KONT);LOCK(OUT);                00022000  003:C187:5
    END OF PROGRAM.                                                                     00085000  003:0190:5
                                                                                     B.0000(003) IS 01A6 LONG
                                                                                           DATA IS 00CE LONG
==========================================================================================================
NUMBER OF ERRORS DETECTED = 0.
NUMBER OF SEGMENTS = 3.  TOTAL SEGMENT SIZE = 454 WORDS.  CORE ESTIMATE = 4280 WORDS.  STACK ESTIMATE = 30
PROGRAM SIZE = 181 CARDS, 1612 SYNTACTIC ITEMS, 27 DISK SEGMENTS.
PROGRAM FILE NAME:  INVB/ISMTGB6700.
COMPILATION TIME = 10.926 SECONDS ELAPSED;  3.349 SECONDS PROCESSING;  0.910 SECONDS I/O.
==========================================================================================================
```

INVB/LISTER

```
$ SET AUTOBIND                                                    C  000:000005
$BIND = FROM MSLIB/=                                              C  000:000005
$INCLUDE "MS/INCLFILE/INVB" *                                     C  000:000005
                                                                   START OF SEGMENT 002
      REAL LAT,LONG,MLT,INVLAT                                    1  002:000000
      INTEGER EFLAG,QUAL                                          1  002:000000
      DIMENSION B(757)                                            1  002:000000
      DIMENSION ASCX(2),DSCX(2),MSECX(2),ALTMX(2),ALONX(2),IKP(2),   1  002:000000
     1GSM(2,3),DST(2,6),COMM(30),GH(17,17),GHT(14,14),E(3)        1  002:000000
      COMMON/INBUF/NSEQB,ITYPEB,NTYPEB,MJDB,MSECB,IPASSB,         1  002:000000
     1   TINTB,LAT(30),LONG(30),RAD(30),MLT(30),INVLAT(30),       1  002:000000
     2              DYPLAT(30),BS(30),BV(30),X(30),Y(30),Z(30),   1  002:000000
     3              BVA(30),BA(30),YA(30),ZA(30),HVSD(30),        1  002:000000
     4           XSD(30),YSD(30),ZSD(30),BMD(30),XMD(30),YMD(30), 1  002:000000
     5           ZMD(30),QUAL(30),SFARF(30)                       1  002:000000
      EQUIVALENCE(NSEQB,B)                                        1  002:000000
$SET OMIT                                                         1    OMIT
C   OLD HEADER FORMAT                                             1    OMIT
      DIMENSION ASCX(2),DSCX(2),MSECX(2),ALTMX(2),ALONX(2),IKP(2) 1    OMIT
      DIMENSION GSM(2,3),DST(2,6),COMM(18),E(3),GH(14,14),GHT(14,14)  1    OMIT
      EQUIVALENCE(NSEQX,B(1)),(ITYPEX,B(2)),(NTYPEX,B(3)),(MJDX,B(4)) 1    OMIT
      EQUIVALENCE(IPASSX,B(5)),(ASCX,B(6)),(DSCX,B(8)),(MSECX,B(10))  1    OMIT
      EQUIVALENCE(ALTMX,B(12)),(ALONX,B(14)),(IKP,B(16)),(GSM,B(18))  1    OMIT
      EQUIVALENCE(DST,B(24)),(JFLAG,B(36)),(KFLAG,B(37)),(EFLAG,B(38))  1    OMIT
      EQUIVALENCE(TZERO,B(39)),(COMM,B(40)),(E,B(58))             1    OMIT
      EQUIVALENCE (GH,B(61)),(GHT,B(257))                         1    OMIT
$POP OMIT                                                         1  002:000000
C---------------------------------------------------------------- 1  002:000000
C   HEADER RECORD FORMAT MODIFIED AS DESCRIBED IN                 1  002:000000
C   "INVESTIGATOR'S TAPES" NOTES OF MARCH 25,1981                 1  002:000000
C---------------------------------------------------------------- 1  002:000000
      EQUIVALENCE (NSEQX,B(1)),(ITYPEX,B(2)),(NTYPEX,B(3)),(MJDX,B(4)), 1  002:000000
     1(IPASSX,B(5)),(ASCX,B(6)),(DSCX,B(8)),(MSECX,B(10)),(ALTMX,B(12)),  1  002:000000
     2(ALONX,B(14)),(IKP,B(16)),(GSM,B(18)),(DST,B(24)),(COMM,B(36)), 1  002:000000
     3(MMAX,B(65)),(NMAX,B(67)),(NONEXT,B(68)),(TZERO,B(69)),     1  002:000000
     4(APAR,B(70)),(GH,B(71)),(GHT,B(340)),(E,B(556))             1  002:000000
      LOGICAL ERRMSG/.FALSE./,EOF/.FALSE./                        1  002:000000
      DIMENSION TIT(14)                                           C  002:000000
      DATA TIT/14*"      "/                                       C  002:000000
      READ(5,500,END=555)TIT                                      C  002:000000
                                                                      FIB IS 0006 LONG
500   FORMAT(13A6,A2)                                             C  002:000800
555   CONTINUE                                                    C  002:000800
      WRITE(6,600)                                                C  002:000800
                                                                      FIB IS 0006 LONG
600   FORMAT(26X,82(1H$))                                         C  002:000C02
      WRITE(6,601)                                                C  002:000C02
601   FORMAT(26X,"$",80(1H ),"$")                                 C  002:001002
      WRITE(6,602)CONCAT(C,TIME(15),A7,15,A5)                     C  002:001002
602   FORMAT(26X,"$",T40,"MAGSAT INVESTIGATOR'S SUMMARY LISTING - DATE = C  002:001802
     1       ,A6,T105,"$")                                        C  002:001802
      WRITE(6,601)                                                C  002:001802
      WRITE(6,603)TIT                                             C  002:001C02
603   FORMAT(26X,"$",13A6,A2,"$")                                 C  002:002302
      DO 100 I=1,10                                               C  002:002302
```

```
C                                                                      C  002:002E:2
203   CALL RDINVB(ERRMSG,EOF)                                          C  002:002E:2
      IF(EOF)GO TO 200                                                 C  002:0030:0
      GO TO (201,202),ITYPEX                                           C  002:0030:5
      WRITE(6,666)                                                     C  002:0039:3
666   FORMAT(1X,"BF,,SE,")                                             C  002:003A:2
C                                                                      C  002:003A:2
C        HEADER RECORD                                                 C  002:003A:2
C                                                                      C  002:003A:2
201   ISBSG=0                                                          C  002:003A:2
      JSBSG=JSBSG+1                                                    C  002:003B:0
      WRITE(6,604)                                                     C  002:003C:2
604   FORMAT(1H0,"   SEQ  TYP NTYP MJD  PASS    LONG1    LONG2   INP1/2")  C  002:0040:2
C    1FLGS",T90,"FIELD MODEL")                                         C  002:0040:2
      WRITE(6,605)NSEQX,JSBSG,ITYPEX,NTYPEX,MJDX,IPASSX,ALONX,INP      C  002:0040:2
C     1            JFLAG,KFLAG,EFLAG,FOWM                              C  002:0056:2
605   FORMAT(1X,I5,"/",2I2,I4,I7,I5,2F9.3,2I4,2X,3I1,3X,18A4)          C  002:0056:2
      WRITE(6,606)                                                     C  002:0056:2
606   FORMAT(1H ,"   SEQ   TYP NTYP MJD  PASS   MSEC     LATI   LONGI  C  002:005A:2
     1 LATC      LONGC",T78,"DB",T93,"DY",T107,"DY",T121,"DZ")         C  002:005A:2
      GO TO 203                                                        C  002:005A:2
C                                                                      C  002:005A:5
C        DATA RECORD                                                   C  002:005A:5
C                                                                      C  002:005A:5
202   ISBSG=ISBSG+1                                                    C  002:005A:5
      WRITE(6,607)NSEQB,ISBSG,ITYPEB,NTYPEB,MJDB,IPASSB,MSECB,LAT(1),  C  002:005C:1
     1            LONG(1),LAT(30),LONG(30),                            C  002:006C:5
     1   (BVA(1)-BVD(1)),(BVA(30)-BVD(30)),                            C  002:0072:2
     2   (XA(1)-XMD(1)),(XA(30)-XMD(30)),                              C  002:0079:2
     3      (YA(1)-YMD(1)),(YA(30)-YMD(30)),                           C  002:0080:2
     4    (ZA(1)-ZMD(1)),(ZA(30)-ZMD(30))                              C  002:00A7:2
      GO TO 203                                                        C  002:0091:2
607   FORMAT(1X,I5,"/",I2,I2,I4,I7,I4,I9,F8.3,F9.3,F8.3,F9.3,2X,8F7.1) C  002:0091:5
C                                                                      C  002:0091:5
C        END OF  FILE INVB                                             C  002:0091:5
C                                                                      C  002:0091:5
200   IF(ERRMSG)GO TO 205                                              C  002:0091:5
      WRITE(6,608)NSEQB,ISTOP                                          C  002:0092:4
608   FORMAT(2H0 ,"EOT, ",I6," RECORDS PROCESSED")                     C  002:009A:1
  205 WRITE(6,609);WRITE(6,608)NSEQB;STOP                              C  002:009A:1
609   FORMAT(1H0,"DATA ERRORS DETECTED")                               C  002:00A6:1
      END                                                              C  002:00A6:1
      002:00A9:3  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 002:0090
                                                                       SEGMENT 002 IS 00B0 LONG
```

```
=================================================================================================

                                                                       FORMAT SEGMENT IS 0090 LONG
                                                                          START OF SEGMENT 005
WARNING:THE SUBROUTINE "RDINVB" WAS NOT FOUND                                   (150)

                                                                          START OF SEGMENT 007
                                                                       SEGMENT 007 IS 000B LONG
                                                                       SEGMENT 005 IS 0013 LONG

      NO ERRORS DETECTED.  NUMBER OF CARDS = 97.
      COMPILATION TIME = 207 SECONDS ELAPSED,  1.60 SECONDS PROCESSING.
      D2 STACK SIZE = 12 WORDS.  FILESIZE = 140 WORDS.  ESTIMATED CORE STORAGE REQUIREMENT = 1152 WORDS.
```

```
NUMBER OF PROGRAM SEGMENTS = 6.  NUMBER OF
PROGRAM CODE FILE = (112AGG)INVB/LISTER1 ON PACK.
COMPILER COMPILED ON 09/07/79 (FORTRAN ON PACK).
```

ORIGINAL PAGE IS
OF POOR QUALITY

MSLIB/SUBS

```
$SET SEPARATE                                                              C  000:0000:5
                                                                            START OF SEGMENT 002
      SUBROUTINE RDINVB(ERRMSG,EOF)                                        C  002:0000:0
      LOGICAL ERRMSG,EOF                                                   C  002:0000:0
       COMMON/INBUF/BUF(757)                                               C  002:0000:0
      EQUIVALENCE (BUF(1),NSEQ),(BUF(2),TYPE)                              C  002:0000:0
C                                                                          C  002:0000:0
C           INVESTIGATOR S READER ROUTINE                                  C  002:0000:0
C                                                                          C  002:0000:0
205   LSEQ=NSEQ+1                                                          C  002:0000:0
202   READ(8,END=200,ERR=201)BUF                                           C  002:0001:3
                                                                               FIB IS 0008 LONG
      IF(NSEQ-LSEQ)202,203,204                                             C  002:0007:0
C***READ ERROR - BLOCK(S) MISSING                                          C  002:0008:0
C                                                                          C  002:000E:0
204   ERRMSG=.TRUE.                                                        C  002:000B:0
      DO 100 LSEQ=LSEQ,NSEQ      -1                                        C  002:000E:4
      WRITE(6,600)LSEQ                                                     C  002:000F:4
                                                                               FIB IS 0008 LONG
600   FORMAT(1H0,"     RDINVB***** READ ERR - BLOCK",I5," IS MISSING")    C  002:0016:2
100   CONTINUE                                                             C  002:0016:2
C*** CHECK TYPE CODE                                                       C  002:0016:5
203   IF(TYPE.LE.2)RETURN                                                  C  002:0016:5
C***PAR ERR ON ORIG TAPE (NSEQ)                                            C  002:0016:2
      ERRMSG=.TRUE.                                                        C  002:0016:2
      WRITE(6,601)NSEQ,TYPE                                                C  002:0019:0
601   FORMAT(1H0,"*****RDINVB***** PAR ERR ON ORIG GSFC TAPE"   BLOCK ",  C  002:0021:2
     1       I5," TYPE =",I12)                                             C  002:0021:2
      GO TO 205                                                            C  002:0021:2
C***PAR ERR ON CONVERTED TAPE                                              C  002:0021:5
201   ERRMSG=.TRUE.                                                        C  002:0021:5
      WRITE(6,602)LSEQ                                                     C  002:0022:3
602   FORMAT(1H0,"*****RDINVB***** PAR ERR BLOCK",I5)                      C  002:0029:2
      LSEQ=LSEQ+1                                                          C  002:0029:2
      GO TO 202                                                            C  002:002A:4
200   EOF=.TRUE.;BLOCK 8                                                   C  002:002B:1
      RETURN                                                               C  002:0034:4
      END                                                                  C  002:0035:1
                                                                          FORMAT SEGMENT IS 002E LONG
      002:003A:2  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 002:0001
                                                                          SEGMENT 002 IS 00AB LONG
```

```
*****************************************************************************************************************

                                                                            START OF SEGMENT 005
                                                                          SEGMENT 005 IS 0016 LONG
      NO ERRORS DETECTED.  NUMBER OF CARDS = 34.
      COMPILATION TIME = 1** SECONDS ELAPSED,  0.89 SECONDS PROCESSING.
      D9 STACK SIZE = 9 WORDS.  FILESIZE = 156 WORDS.  ESTIMATED CORE STORAGE REQUIREMENT = 1060 WORDS.
      TOTAL PROGRAM CODE = 132 WORDS.  ARRAY STORAGE = 757 WORDS.
      NUMBER OF PROGRAM SEGMENTS = 5.  NUMBER OF DISK SEGMENTS = 20.
      PROGRAM CODE FILE = (112468)MSLIB/RDINVB ON PACK.
      COMPILER COMPILED ON 09/07/79 (FORTRAN ON PACK).
```

22.

```
---BURROUGHS B6700 PROGRAM BINDER

                                  I N V 3 / L I S T E R 1
                                  * * * * * * * * * * * * * *

BIND = FROM WSLIB/=
CBIND = FROM INV3/=)
BEGIN BINDING RDINV3 OF .OUT FROM WSLIB/RDINV3
      RDINV3              (02,0002) CHANGED TO (02,0004)
      FILE6               (02,0007) CHANGED TO (02,0009)
      FILE8               (02,0006) CHANGED TO (02,000C)
      /INBUF/             (02,0003) CHANGED TO (02,0002)
      <SEG DICT ITEM>     (01,0002) CHANGED TO (01,0007) = 03 030004B00006
      <SEG DICT ITEM>     (01,0004) CHANGED TO (01,0009) = 05 07000000000A
      <SEG DICT ITEM>     (01,0006) CHANGED TO (01,000A) = 05 09000254000A
END OF BINDING RDINV3

************************************************************************************************
NUMBER OF ERRORS DETECTED = 0.
HOST FILE = HOST
SEGMENT DICTIONARY LENGTH = 11.  GLOBAL STACK SIZE = 14.  STACK ESTIMATE = 512.
CORE ESTIMATE = 1192 WORDS.  CODE FILE LENGTH = 35 DISK SEGMENTS.
BINDING TIME = 117 SECONDS ELAPSED, 2.42 SECONDS PROCESSOR, 2.02 SECONDS I/O.
************************************************************************************************
```

ORIGINAL PAGE IS
OF POOR QUALITY

```
MAGSAT INVESTIGATOR-B SUMMARY LISTING - DATE 810912

SA*000505 CONV FRM OF8023 "INVS SELECTED QUIET TIME"  NOV 02 - JAN 18

SEC   TYP NTYP WJD   PASS   LONG1     LONG2    IKP1/2
 1/ 1  1   2  44179   12    -5.788   162.686   17  17
SEC   TYP NTYP WJD   PASS   MSEC      LATI     LONGI     LATO     LONGO       DB              DX              DY              DZ
 2/ 1  2   2  44179  12 55643100 -24.607   -1.065  -15.787   -2.798  77440.2  -47.468217.7   34.7*******  114.5*******   62.4
 3/ 2  2   2  44179  12 55792662 -15.482   -2.956   -5.524   -4.552    -48.0  -62.0   31.1  -59.4  117.1  102.7   59.9  -11.2
 4/ 3  2   2  44179  12 55940126  -6.317   -4.649    2.580   -6.468    -63.0  -65.3  -55.6  -12.9  102.0  105.5   -4.1  178.2
 5/ 4  2   2  44179  12 56087580   2.886   -6.325   11.826   -8.006    -69.3  -84.4  -29.1  -67.7   10.5   -9.8   90.4    1.3
 6/ 5  2   2  44179  12 56235052  12.135   -8.085   21.114   -9.620    -64.371872.4  -67.974221.1  -13.1*******    -1.987255.7
 7/ 6  2   1  44179  12 66382516  21.474   -9.892   30.439  -11.823    -51.2  -10.2  -37.9  -81.9 -129.2 -117.8  -79.0   50.1

SEC   TYP NTYP WJD   PASS   LONG1     LONG2    IKP1/2
 8/ 2  1   2  44179   13   -29.268   139.229   17  17
SEC   TYP NTYP WJD   PASS   MSEC      LATI     LONGI     LATO     LONGO       DB              DX              DY              DZ
 9/ 1  2   2  44179  13 70503216 -45.718   -9.453  -57.174  -14.723      9.1    1.0   27.4  -55.6   57.7   47.6   -4.0  -42.6
10/ 2  2   2  44179  13 70747677 -26.877  -14.965  -49.221  -18.321      2.0    2.0  -19.6  -11.3   65.2   52.2  -26.1  -70.6
11/ 3  2   2  44179  13 70855180 -47.021  -18.623*********99999.000      2.7    0.0    3.5    0.0   42.5    3.0   -0.8    0.0
12/ 4  2   2  44179  13 71275333 -24.590  -24.484  -15.700  -26.274    -24.3  -36.4  -15.9  -69.2   43.3    7.9    2.0  -34.0
13/ 5  2   2  44179  13 71423787 -15.395  -26.336   -6.535  -28.029    -39.0  -50.4  -69.8  -51.7    7.5   18.8  -34.0   -7.1
14/ 6  2   2  44179  13 71571240  -6.229  -28.207    2.570  -29.745    -49.7  -47.1  -46.2  -42.8   28.6   21.8   -4.1   22.8
15/ 7  2   2  44179  13 71719723   2.978  -29.843   11.917  -31.484    -46.8  -43.0  -49.2  -52.4    3.7  -22.5   -9.4   -6.5
16/ 8  2   2  44179  13 71865197  12.226  -31.543   21.206  -33.308    -41.2  -32.1  -46.1  -28.7  -39.0  -47.9  -51.4  -34.6
17/ 9  2   1  44179  13 72013650  21.516  -33.372   30.533  -35.308    -31.3  -21.4  -52.3  -41.4  -37.4  -61.6    6.0   -9.6

SEC   TYP NTYP WJD   PASS   LONG1     LONG2    IKP1/2
18/ 3  1   2  44179   14   -52.710   115.768   10  10
SEC   TYP NTYP WJD   PASS   MSEC      LATI     LONGI     LATO     LONGO       DB              DX              DY              DZ
19/ 1  2   2  44179  14 76152476 -70.266  -28.566  -61.936  -35.648     13.4    2.0  -19.2  -15.8   23.0   17.3  -27.5  -13.7
20/ 2  2   2  44179  14 76299019 -61.541  -35.828  -52.933  -40.649      2.8   -3.6  -25.7  -39.4   26.0   15.8  -20.0  -25.8
21/ 3  2   2  44179  14 76447392 -52.635  -40.108  -43.947  -43.147     -3.7  -15.3  -30.1  -49.7   15.8    4.2  -18.4  -24.4
22/ 4  2   2  44179  14 76594946 -43.666  -43.236  -34.908  -45.389    -16.1  -29.3  -45.0  -45.4    9.9   16.3  -27.9  -11.6
23/ 5  2   2  44179  14 76742300 -34.606  -45.603  -25.927  -47.648    -29.7  -37.3  -45.2  -57.3   17.0   -4.5  -11.2  -22.0
24/ 6  2   2  44179  14 76889772 -25.593  -47.733  -16.706  -49.540    -37.6  -44.5  -56.5  -44.7   -5.2    8.6  -20.2    1.4
25/ 7  2   2  44179  14 77037236 -16.401  -49.600   -7.546  -51.301    -48.6  -47.0  -44.4  -38.2    9.0    7.8    2.5    8.4
26/ 8  2   2  44179  14 77184690  -7.240  -51.359    1.656  -53.019    -47.5  -40.1  -48.8  -44.7    3.7  -11.3   -4.0   -6.2
27/ 9  2   2  44179  14 77332162   1.963  -53.076   10.899  -54.751    -40.4  -33.0  -41.0  -42.4  -15.3   -4.8  -16.2   -2.4
28/10  2   2  44179  14 77479625  11.208  -54.810   20.184  -56.563    -32.5  -16.2  -47.9  -33.9   11.7  -19.0   12.4    6.6
29/11  2   2  44179  14 77627089  20.494  -56.626   29.508  -58.335    -17.6   -2.8  -32.5   -2.2  -19.4  -19.9    6.3   -5.2
30/12  2   1  44179  14 77774552  29.870  -58.665   38.865  -60.795     -0.9    0.0   -2.4  -38.4  -18.2  -25.4   -9.7   12.4

SEC   TYP NTYP WJD   PASS   LONG1     LONG2    IKP1/2
31/ 4  1   2  44179   15   -76.171    92.309   10  10
SEC   TYP NTYP WJD   PASS   MSEC      LATI     LONGI     LATO     LONGO       DB              DX              DY              DZ
```

INVB/LISTER2

```
$SET AUTOBIND                                                              C  000:0000:5
$BIND = FROM MSLIB/=                                                       C  000:0000:5
$INCLUDE "MS/INCLFILE/INVB" =                                              C  000:0000:5
                                                                            START OF SEGMENT: 002
                                                                          FORMAT SEGMENT IS 000F LONG
      REAL LAT,LONG,MLT,INVLAT                                             1  002:0000:0
      INTEGER EFLAG,QUAL                                                   1  002:0000:0
      DIMENSION B(757)                                                     1  002:0000:0
      DIMENSION ASCX(2),DSCX(2),MSECX(2),ALTMX(2),ALONX(2),IKP(2),         1  002:0000:0
     1GSM(2,3),DST(2,6),COMM(30),GH(17,17),GHT(14,14),E(3)                 1  002:0000:0
      COMMON/INBUF/NSEQB,ITYPEB,NTYPEB,MJDB,MSECB,IPASSB,                  1  002:0000:0
     1  TINTB,LAT(30),LONG(30),RAD(30),MLT(30),INVLAT(30),                 1  002:0000:0
     2            DIPLAT(30),BS(30),BV(30),X(30),Y(30),Z(30),              1  002:0000:0
     3            BVA(30),XA(30),YA(30),ZA(30),BVSD(30),                   1  002:0000:0
     4          XSD(30),YSD(30),ZSD(30),BMD(30),XMD(30),YMD(30),           1  002:0000:0
     5         ZMD(30),QUAL(30),SPARE(30)                                  1  002:0000:0
      EQUIVALENCE(NSEQB,B)                                                 1  002:0000:0
$SET OMIT                                                                  1    OMIT
C    OLD HEADER FORMAT                                                     1    OMIT
      DIMENSION ASCX(2),DSCX(2),MSFCX(2),ALTMX(2),ALONX(2),IKP(2)          1    OMIT
      DIMENSION GSM(2,3),DST(2,6),COMM(18),E(3),GH(14,14),GHT(14,14)       1    OMIT
      EQUIVALENCE(NSEQX,B(1)),(ITYPEX,B(2)),(NTYPEX,B(3)),(MJDX,B(4))      1    OMIT
      EQUIVALENCE(IPASSX,B(5)),(ASCX,B(6)),(DSCX,B(8)),(MSECX,B(10))       1    OMIT
      EQUIVALENCE(ALTMX,B(12)),(ALONX,B(14)),(IKP,B(16)),(GSM,B(18))       1    OMIT
      EQUIVALENCE(DST,B(24)),(JFLAG,B(36)),(KFLAG,B(37)),(EFLAG,B(38))     1    OMIT
      EQUIVALENCE(TZERO,B(39)),(COMM,B(40)),(E,B(58))                      1    OMIT
      EQUIVALENCE (GH,B(61)),(GHT,B(257))                                  1    OMIT
$POP OMIT                                                                  1  002:0000:0
C-----------------------------------------------------------------         1  002:0000:0
C    HEADER RECORD FORMAT MODIFIED AS DESCRIBED IN                         1  002:0000:0
C    "INVESTIGATOR-B TAPES" NOTES OF MARCH 25,1981                         1  002:0000:0
C-----------------------------------------------------------------         1  002:0000:0
      EQUIVALENCE (NSEQX,B(1)),(ITYPEX,B(2)),(NTYPEX,B(3)),(MJDX,B(4)),    1  002:0000:0
     1(IPASSX,B(5)),(ASCX,B(6)),(DSCX,B(8)),(MSECX,B(10)),(ALTMX,B(12)),   1  002:0000:0
     2(ALONX,B(14)),(IKP,B(16)),(GSM,B(18)),(DST,B(24)),(COMM,B(36)),      1  002:0000:0
     3(NMAX,B(66)),(NMAXT,B(67)),(MODEXT,B(68)),(TZERO,B(69)),             1  002:0000:0
     4(ABAR,B(70)),(GH,B(71)),(GHT,B(360)),(E,B(556))                      1  002:0000:0
      LOGICAL ERRMSG/.FALSE./,EOF/.FALSE./                                 1  002:0000:0
C-----------------------------------------------------------------         C  002:0000:0
C    THIS PROGRAM LISTS INVESTIGATOR-B TAPES                               C  002:0000:0
C       -ALLINFORMATION CONTAINED IN HEADER & DATA RECORDS                 C  002:0000:0
C        (EXCEPT THE INTERNAL FIELD MODEL COEFS.) IS PRINTED OUT           C  002:0000:0
C       -TOTAL INTENSITY AND VECTOR ANOMALIES ARE COMPUTED,                C  002:0000:0
C        LISTED AND PRINTER-PLOTTED                                        C  002:0000:0
C-----------------------------------------------------------------         C  002:0000:0
C                                                                          C  002:0000:0
C    DECLARATIONS PERTINENT TO THIS PROGRAM                                C  002:0000:0
C                                                                          C  002:0000:0
      DIMENSION BUF(14),DB(30),DX(30),DY(30),        DZ(30)                C  002:0000:0
      DIMENSION  IB(30),IX(30),IY(30),IZ(30)                               C  002:0000:0
      DATA BUF/14*"......"/                                                C  002:0000:0
      DATE=CONCAT(0,TIME(15),47,15,48)                                     C  002:0000:0
      NSLUB=0                                                              C  002:0002:2
      READ(5,500,END=555)BUF                                               C  002:0003:2
                                                                             FIB IS 0006 LONG
```

ORIGINAL PAGE IS
OF POOR QUALITY

```
500   FORMAT(14A6)                                                         C  002:0008:0
C   READ STARTING RECORD NUMBER - 1                                        C  002:0008:0
      READ(5,/,END=555)NSEQB                                               C  002:0008:0
555   CONTINUE                                                             C  002:0013:0
200   CALL RDINVB(ERRMSG,EOF)                                              C  002:0013:0
      IF(EOF)GO TO 299                                                     C  002:0014:4
      GO TO (201,202),ITYPEX                                               C  002:0015:3
      WRITE(6,666);STOP                                                    C  002:001B:0
                                                                              FIB IS 0006 LONG
666   FORMAT(1X,"#<$*<#*$")                                                C  002:0020:1
C   HEADER RECORD                                                          C  002:0020:1
201   WRITE(6,600)DATE,BUF                                                 C  002:0020:1
600   FORMAT("1MAGSAT INVESTIGATOR-B LISTING...DATE ",A6,3X,13A6,A2)       C  002:0028:2
 $SET OMIT                                                                 C    OMIT
C***OLD HEADER FORMAT***                                                   C    OMIT
      WRITE(6,601)                                                         C    OMIT
601   FORMAT("-     SEQ        MJD    PASS   ASCX1   ASCX2   DSCX1   DSCX2     M   C    OMIT
     1SEC1     MSEC2   LOCTM1 LOCTM2      LONG1      LONG2    IKP1/2    FLGS")     C    OMIT
      WRITE(6,602)NSEQX,NSBSQX,MJDX,IPASSX,ASCX,DSCX,MSECX,ALTMX,ALONX,    C    OMIT
     1            IKP,JFLAG,KFLAG,EFLAG                                    C    OMIT
602   FORMAT(1X,I5,"/",I5,I7,I6,4F7.1,1X,2I9,1X,2F7.3,1X,2F9.3,            C    OMIT
     2        1X,2I4,3X,3I1)                                               C    OMIT
      WRITE(6,603)((GSM(I,J),J=1,3),I=1,2)                                 C    OMIT
603   FORMAT("-GSM ASC. X=",F8.1," Y=",F8.1," Z=",F8.1,/,                  C    OMIT
     1        " GSM DSC. X=",F8.1," Y=",F8.1," Z=",F8.1)                   C    OMIT
      WRITE(6,604)((DST(I,J),J=1,6),I=1,2)                                 C    OMIT
604   FORMAT("-DST ASC.",6F9.1,/," DST DSC.",6F9.1)                        C    OMIT
      WRITE(6,605)E                                                        C    OMIT
605   FORMAT("-EXT. FIELD MODEL",3F9.1)                                    C    OMIT
      WRITE(6,606)COMM,TZERO                                               C    OMIT
606   FORMAT("-INT. FIELD MODEL :",18A4,5X,"[TZERO=",F11.6,"]")            C    OMIT
 $POP OMIT                                                                 C  002:0028:2
      NSBSQX=NSBSQX+1                                                      C  002:0028:2
      WRITE(6,601)NSEQX,ITYPEX,MJDX,MSECX(1),IPASSX,ASCX(1),DSCX(1),       C  002:0029:4
     .             ALTMX(1),ALONX(1)                                       C  002:0038:5
601   FORMAT("0SEQ",I6,"   TYPE",I2,"   MJD",I6,"   MSEC",I9,"   PASS",    C  002:003F:2
     .I5,"   ASCX",F9.1,"   DSCX",F9.1,"   LTM",F7.3,"   ALONX",F9.3)      C  002:003F:2
      WRITE(6,602)NSBSQX,NITYPEX,MSECX(2),ASCX(2),DSCX(2),ALTMX(2),        C  002:003F:2
     .             ALONX(2)                                                C  002:004C:4
602   FORMAT(1X,T6,I5,T19,I1,T40,I8,T67,F9.1,T83,F9.1,T98,F7.3,T113,F9.3   C  002:0051:2
     .)                                                                    C  002:0051:2
      WRITE(6,603)IKP(1),(GSM(1,I),I=1,3),(DST(1,I),I=1,6)                 C  002:0051:2
603   FORMAT("0IKP",I4,"   GSM",3F9.1,"   DST",6F9.1)                      C  002:0067:2
      WRITE(6,604)IKP(2),(GSM(2,I),I=1,3),(DST(2,I),I=1,6)                 C  002:0067:2
604   FORMAT(1X,T6,I3,T15,3F9.1,T48,6F9.1)                                 C  002:007D:2
      WRITE(6,605)COMM                                                     C  002:007D:2
605   FORMAT("0",30A4)                                                     C  002:0086:2
      WRITE(6,606)NMAX,NMAXT,MODEXT,TZERO,ABAR,E                           C  002:0086:2
606   FORMAT("0NMAX",I3,"   NMAXT",I3,"   MODEXT",I2,"   TZERO",F10.4,     C  002:0098:2
     .*"  ABAR",F7.1,"   EXT. FIELD",3F9.1)                                C  002:0098:2
      NSBSQB=0                                                             C  002:009E:2
      GO TO 200                                                            C  002:0099:0
C   DATA RECORD                                                            C  002:0099:3
202   NSBSQB=NSBSQB+1                                                      C  002:0099:3
      WRITE(6,608)                                                         C  002:009A:5
      WRITE(6,607)NSEQB,NSBSQB,MJDB,MSECB,IPASSB,TINTB                     C  002:009F:2
608   FORMAT("1     SEQ        MJD      MSEC      PASS     TINT ")         C  002:00AF:2
607   FORMAT(1X,I5,"/",I5,I7,I10,I6,F8.1)                                  C  002:00AF:2
      WRITE(6,609)                                                         C  002:00AF:2
609   FORMAT("0 J      LAT        LONG         RAD        MLT     INVLAT     DIPL   C  002:00B3:2
```

ORIGINAL PAGE IS
OF POOR QUALITY

```
     .AI        BS        BV          X          Y          Z          BVA")         C   002:00B3:2
     WRITE(6,610)(J,LAT(J),LONG(J),RAD(J),MLT(J),INVLAT(J),                          C   002:00B3:2
    .           DIPLAT(J),BS(J),BV(J),X(J),Y(J),Z(J),BVA(J),J=1,30)                  C   002:00C3:4
610  FORMAT(30(  1X,I2,2F10.1,F10.2,3F9.3,2F10.1,1X,4F10.1,/))                       C   002:00DB:2
     WRITE(6,611)                                                                    C.  002:00DB:2
611  FURMAT("O J      XA        YA        ZA       BVSD     XSD      YSD            C   002:00DF:2
    . ZSD    BMD      XMD       YMD       ZMD       QUAL              SPARE"         C   002:00DF:2
    1)                                                                               C   002:00DF:2
     WRITE(6,612)(J,XA(J),YA(J),ZA(J),BVSD(J),XSD(J),YSD(J),ZSD(J),                  C   002:00DF:2
    .          BMD(J),XMD(J),YMD(J),ZMD(J),QUAL(J)+100000,                           C   002:00F5:2
    -        SPARE(J),J=1,30)                                                        C   002:0103:5
612  FORMAT(30(  1X,I2,3F10.1,1X,4F7.1,F9.1,3F10.1,I10,5X,Z12,                        C   002:010D:2
    -        T106,1X,/))                                                             C   002:010D:2
C    COMPUTATION, PRINTOUT & PLOTTING OF ANOMALIES                                   C   002:010D:2
     DATA AB,AX,AY,AZ/4*50./                                                         C   002:010D:2
     FB=50./AB;FX=50./AX;FY=50./AY;FZ=50./AZ                                         C   002:010D:2
     DO 101 J=1,30                                                                   C   002:0112:4
     DIF=BVA(J)-BMD(J);DB(J)=DIF;IB(J)=MAXO(32,MINO(132,82+FB*DIF))                  C   002:0114:0
     DIF=XA(J) -XMD(J);DX(J)=DIF;IX(J)=MAXO(32,MINO(132,82+FX*DIF))                  C   002:0120:0
     DIF=YA(J) -YMD(J);DY(J)=DIF;IY(J)=MAXO(32,MINO(132,82+FY*DIF))                  C   002:012C:0
     DIF=ZA(J) -ZMD(J);DZ(J)=DIF;IZ(J)=MAXO(32,MINO(132,82+FZ*DIF))                  C   002:0138:0
101  CONTINUE                                                                        C   002:0144:0
     WRITE(6,613)                                                                    C   002:0146:1
613  FORMAT("O J      DB       DX       DY       DZ",T66,                            C   002:014A:2
    1           "NEG ANOMALY  <- 0 -> POS ANOMALY",/,1X,T32,                         C   002:014A:2
    2               "I",9("---------,"),"---------I")                                C   002:014A:2
     WRITE(6,614)(J,DB(J),DX(J),DY(J),DZ(J),                                         C   002:014A:2
    .             IB(J),IX(J),IY(J),IZ(J),J=1,30)                                    C   002:0157:4
614  FORMAT(30(  1X,I2,4F7.1,T32,"I",T82,".",T132,"I",                               C   002:0167:2
    .          T*,"B",T*,"X",T*,"Y",T*"Z",/)          )                              C   002:0167:2
     WRITE(6,615)                                                                    C   002:0167:2
615  FORMAT(1H+,T32,"I",9("---------,"),"---------I")                                C   002:016B:2
     GO TO 200                                                                       C   002:016B:2
299  IF(ERRMSG)WRITE(6,616)                                                          C   002:016B:5
616  FORMAT("O***SEE DIAGNOSTIC MESSGS PRINTED BY INVB READER ROUTINE")              C   002:0170:2
     WRITE(6,617)NSEWB                                                               C   002:0170:2
617  FORMAT("DEBT, ",I5," RECORDS PROCESSED")                                        C   002:0177:2
     STOP                                                                            C   002:0177:2
     END                                                                             C   002:0178:1
     002:0178:3  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 002:000B
     002:017E:4  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 002:0003
                                                                        SEGMENT 002 IS 01A0 LONG

=================================================================================================

                                                                        FORMAT SEGMENT IS 006C LONG
                                                                           START OF SEGMENT 006
                                                                                 (150)
WARNING:THE SUBROUTINE "RUINVB" WAS NOT FOUND

                                                                           START OF SEGMENT 009
                                                                        SEGMENT 009 IS 000B LONG
                                                                        SEGMENT 006 IS 0026 LONG

     NO ERRORS DETECTED.  NUMBER OF CARDS = 150.
     COMPILATION TIME = 6 SECONDS ELAPSED,  2.45 SECONDS PROCESSING.
     D2 STACK SIZE = 25 WORDS.  FILESIZE = 140 WORDS.  ESTIMATED CORE STORAGE REQUIREMENT = 1726 WORDS.
     TOTAL PROGRAM CODE = 520 WORDS.  ARRAY STORAGE = 1011 WORDS.
     NUMBER OF PROGRAM SEGMENTS = 8.  NUMBER OF DISK SEGMENTS = 45.
     PROGRAM CODE FILE = (112AGG)INVB/LISTER2 ON PACK.
     COMPILER COMPILED ON 09/07/79 (FORTRAN ON PACK).
```

```
$SET SEPARATE                                                                          C  000:0000:5
                                                                                        START OF SEGMENT 002
      SUBROUTINE RDINVB(ERRMSG,EOF)                                                    C  002:0000:0
      LOGICAL ERRMSG,EOF                                                               C  002:0000:0
       COMMON/INBUF/BUF(75/)                                                           C  002:0000:0
      EQUIVALENCE (BUF(1),NSEQ),(BUF(2),TYPE)                                          C  002:0000:0
C                                                                                      C  002:0000:0
C         INVESTIGATOR B READER ROUTINE                                                C  002:0000:0
C                                                                                      C  002:0000:0
205   LSEQ=NSEQ+1                                                                      C  002:0000:0
202   READ(8,END=200,ERR=201)BUF                                                       C  002:0001:3
                                                                                           FIB IS 0006 LONG
      IF(NSEQ-LSEQ)202,203,204                                                         C  002:0007:0
C***READ ERROR - BLOCK(S) MISSING                                                      C  002:0008:0
C                                                                                      C  002:0008:0
204   ERRMSG=.TRUE.                                                                    C  002:0008:0
      DO 100 LSEQ=LSEQ,NSEQ     -1                                                     C  002:0008:4
      WRITE(6,600)LSEQ                                                                 C  002:000F:4
                                                                                           FIB IS 0006 LONG
600   FORMAT(1HO,"     RDINVB***** READ ERR - BLOCK#",I5," IS MISSING")                C  002:0016:2
100   CONTINUE                                                                         C  002:0016:2
C*** CHECK TYPE CODE                                                                   C  002:0016:5
203   IF(TYPE.LE.2)RETURN                                                              C  002:0016:5
C***FAR ERR ON ORIG TAPE (GSFC)                                                        C  002:0016:2
      ERRMSG=.TRUE.                                                                    C  002:0018:2
      WRITE(6,601)NSEQ,TYPE                                                            C  002:0019:0
601   FORMAT(1HO,"*****RDINVB***** PAR ERR ON ORIG GSFC TAPE-   BLOCK ",               C  002:0021:2
     1        I5," TYPE =",Z12)                                                        C  002:0021:2
      GO TO 205                                                                        C  002:0021:2
C***FAR ERR ON CONVERTED TAPE                                                          C  002:0021:5
201   ERRMSG=.TRUE.                                                                    C  002:0021:5
      WRITE(6,602)LSEQ                                                                 C  002:0022:3
602   FORMAT(1HO,"*****RDINVB***** PAR ERR BLOCK#",I5)                                 C  002:0029:2
      LSEQ=LSEQ+1                                                                      C  002:0029:2
      GO TO 202                                                                        C  002:002A:4
200   EOF=.TRUE.;LOCK 8                                                                C  002:002B:1
      RETURN                                                                           C  002:0034:4
      END                                                                              C  002:0035:1
                                                                                   FORMAT SEGMENT IS 0028 LONG
      002:004A:2  IS THE LOCATION FOR EXCEPTIONAL ACTION ON THE I/O STATEMENT AT 002:0001
                                                                                   SEGMENT 002 IS 004B LONG

==================================================================================================================

                                                                                        START OF SEGMENT 005
                                                                                   SEGMENT 005 IS 0016 LONG
      NO ERRORS DETECTED.  NUMBER OF CARDS = 34.
      COMPILATION TIME = 5 SECONDS ELAPSED,  0.85 SECONDS PROCESSING.
      D2 STACK SIZE = 9 WORDS.  FILESIZE = 156 WORDS.  ESTIMATED CORE STORAGE REQUIREMENT = 1068 WORDS.
      TOTAL PROGRAM CODE = 132 WORDS.  ARRAY STORAGE = 757 WORDS.
      NUMBER OF PROGRAM SEGMENTS = 5.  NUMBER OF DISK SEGMENTS = 20.
      PROGRAM CODE FILE = (112AGG)NSLIB/RDINVB ON PACK.
      COMPILER COMPILED ON 09/07/79 (FORTRAN ON PACK).
```

ORIGINAL PAGE IS
OF POOR QUALITY

```
                              I N V B / L I S T E R 2
                              = = = = = = = = = = = = =

BIND = FROM MSLIB/=                                                    ;
CBINL = FROM INVB/=;
BEGIN BINDING RDINVB OF .OUT FROM MSLIB/RDINVB
      RDINVB              (02,0002) CHANGED TO (02,000E)
      FILE6               (02,0007) CHANGED TO (02,000F)
      FILE8               (02,0006) CHANGED TO (02,0019)
      /INBUF/             (02,0003) CHANGED TO (02,0002)
      <SEG DICT ITEM>     (01,0002) CHANGED TO (01,0009) = 03 00000460000A
      <SEG DICT ITEM>     (01,0004) CHANGED TO (01,000B) = 05 070000000004
      <SEG DICT ITEM>     (01,0006) CHANGED TO (01,000C) = 05 08000284000E
END OF BINDING RDINVB

=========================================================================================
NUMBER OF ERRORS DETECTED = 0.
HOST FILE = HOST
SEGMENT DICTIONARY LENGTH = 13.  GLOBAL STACK SIZE = 27.  STACK ESTIMATE = 512.
CORE ESTIMATE = 1726 WORDS.  CODE FILE LENGTH = 52 DISK SEGMENTS.
BINDING TIME = 8 SECONDS ELAPSED, 3.16 SECONDS PROCESSOR, 2.43 SECONDS I/O.
=========================================================================================
```

ORIGINAL PAGE IS
OF POOR QUALITY

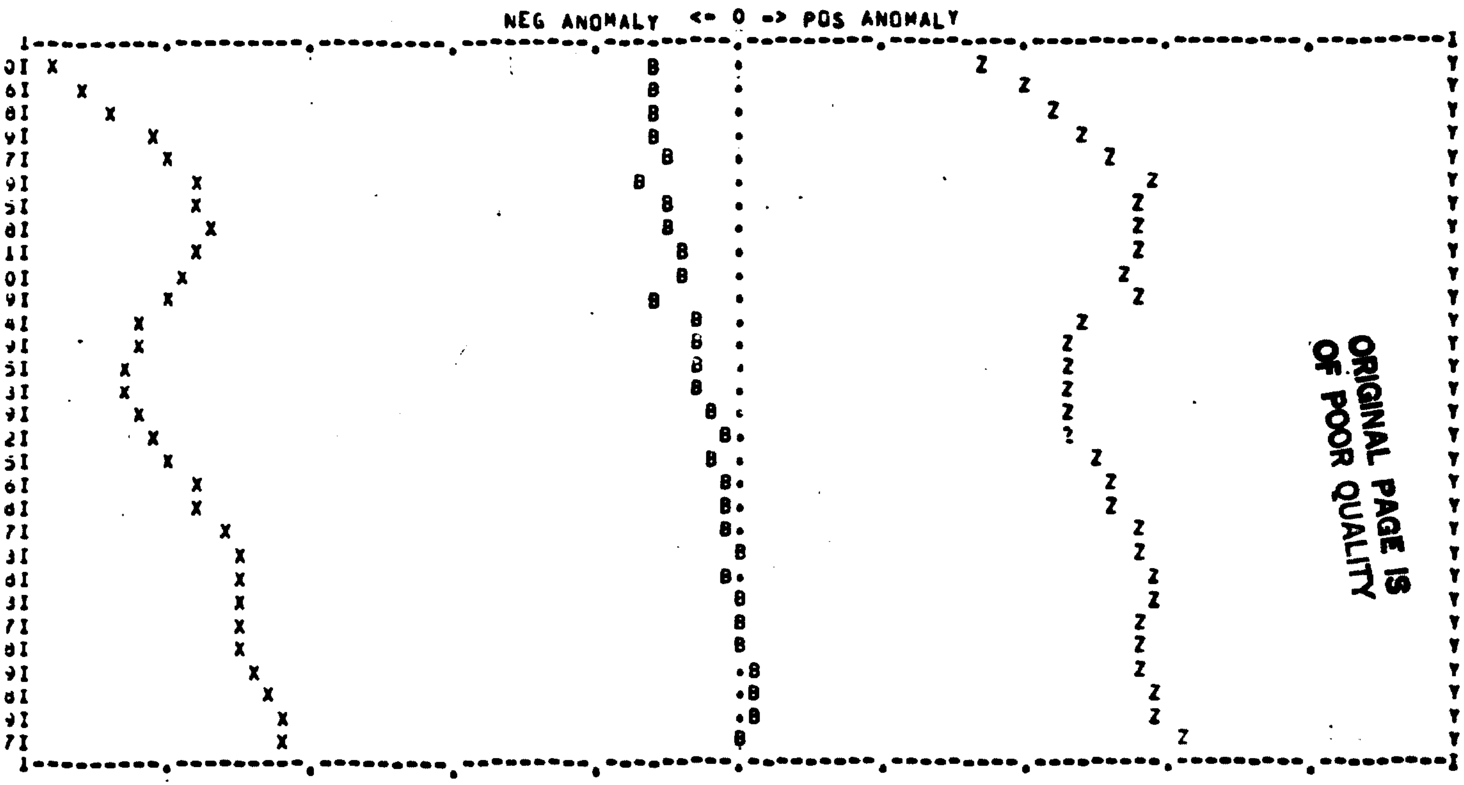
SEQ		MJD	MSEC	PASS	TINT
617	1	44179	41314725	7	4915.4

J	LAT	LONG	RAD	MLT	INVLAT	DIPLAT	BS	BV	X	Y	Z	EVA
1	-41.9	-88.9	6656.71	5.920	33.807	-27.433	27743.4	27744.0	18163.9	6352.9	-19986.1	27744.0
2	-42.2	-89.0	6657.29	5.919	34.050	-27.680	27864.9	27865.6	18128.0	6399.1	-20172.2	27864.7
3	-42.5	-89.1	6657.87	5.917	34.293	-27.927	99999.0	27988.2	18092.2	6445.6	-20358.5	27987.5
4	-42.8	-89.2	6658.45	5.915	34.538	-28.173	28112.0	28112.4	18056.6	6491.2	-20545.8	28111.3
5	-43.2	-89.2	6659.03	5.913	34.783	-28.419	99999.0	28237.5	18020.4	6537.2	-20733.7	28236.3
6	-43.5	-89.3	6659.61	5.911	35.029	-28.664	28362.7	28363.6	17983.5	6583.5	-20922.3	28360.9
7	-43.8	-89.4	6660.18	5.909	35.276	-28.909	99999.0	28490.0	17946.2	6627.6	-21111.4	28489.3
8	-44.1	-89.5	6660.76	5.908	35.523	-29.154	28617.9	28618.8	17909.0	6672.2	-21302.3	28617.4
9	-44.4	-89.6	6661.34	5.906	35.771	-29.399	28747.6	28748.6	17870.7	6717.6	-21494.1	28746.8
10	-44.7	-89.7	6661.91	5.904	36.019	-29.644	99999.0	28878.4	17830.6	6762.0	-21686.3	28877.2
11	-45.0	-89.8	6662.49	5.902	36.260	-29.888	29009.3	29009.6	17790.3	6806.8	-21879.6	29006.2
12	-45.3	-89.9	6663.06	5.900	36.518	-30.132	29141.3	29142.0	17750.8	6852.4	-22072.8	29140.8
13	-45.6	-90.0	6663.64	5.898	36.769	-30.376	29275.1	29274.9	17710.6	6896.0	-22266.4	29274.0
14	-45.9	-90.1	6664.21	5.896	37.020	-30.620	99999.0	29409.1	17671.6	6941.1	-22459.6	29408.3
15	-46.2	-90.2	6664.78	5.894	37.272	-30.865	29544.3	29544.1	17631.7	6986.5	-22653.1	29543.5
16	-46.5	-90.3	6665.35	5.892	37.524	-31.109	29660.9	29680.7	17593.2	7031.7	-22846.9	29679.7
17	-46.8	-90.4	6665.92	5.890	37.777	-31.353	99999.0	29818.0	17554.2	7076.1	-23041.1	29817.7
18	-47.2	-90.5	6666.49	5.888	38.030	-31.597	99999.0	29955.6	17515.0	7121.6	-23234.6	29954.8
19	-47.5	-90.6	6667.05	5.886	38.284	-31.841	30095.0	30095.1	17476.0	7166.7	-23429.5	30093.6
20	-47.8	-90.7	6667.63	5.384	38.539	-32.085	30234.6	30234.0	17435.3	7211.2	-23624.2	30233.7
21	-48.1	-90.8	6668.19	5.882	38.794	-32.330	99999.0	30374.3	17394.9	7255.4	-23819.6	30373.6
22	-48.4	-90.9	6668.76	5.880	39.050	-32.575	30516.0	30516.2	17354.6	7300.3	-24015.8	30515.7
23	-48.7	-91.0	6669.32	5.878	39.307	-32.820	30659.1	30658.[illegible]	17312.2	7345.0	-24213.3	30657.1
24	-49.0	-91.1	6669.88	5.876	39.564	-33.065	30802.1	30801.6	17269.0	7388.8	-24411.9	30800.1
25	-49.3	-91.2	6670.45	5.874	39.821	-33.310	99999.0	30944.9	17224.4	7431.6	-24610.6	30943.8
26	-49.6	-91.3	6671.01	5.872	40.079	-33.556	31096.0	31089.4	17180.6	7475.7	-24809.2	31088.5
27	-49.9	-91.4	6671.57	5.870	40.338	-33.802	31235.3	31235.4	17137.8	7519.5	-25008.0	31234.2
28	-50.2	-91.5	6672.13	5.867	40.597	-34.049	31380.7	31380.7	17092.3	7563.4	-25207.0	31379.8
29	-50.5	-91.6	6672.69	5.865	40.857	-34.295	99999.0	31527.5	17046.7	7607.2	-25407.2	31526.5
30	-50.8	-91.7	6673.24	5.863	41.117	-34.543	31675.0	31674.7	17000.3	7650.0	-25607.8	31672.1

J	XA	YA	ZA	BVSD	XSD	YSD	ZSD	BMD	XMD	YMD	ZMD	QUAL	SPARE
1	18163.6	6353.1	-19986.2	35.1	10.5	13.4	54.0	27749.3	18211.4	6183.6	-20003.2	09999	451869F04040
2	18128.0	6398.9	-20171.0	35.5	10.4	13.4	54.1	27870.6	18173.4	6228.7	-20191.6	09999	451869F04040
3	18092.3	6445.1	-20357.5	35.8	10.4	13.4	54.2	27993.0	18135.5	6273.6	-20380.3	09999	451869F04040
4	18056.6	6491.1	-20544.4	36.1	10.5	13.4	54.4	28116.6	18097.6	6318.5	-20569.3	09999	451869F04040
5	18020.5	6537.1	-20732.1	36.5	10.5	13.2	54.6	28241.2	18059.6	6363.4	-20758.7	09999	451869F04040
6	17984.2	6582.3	-20918.6	37.0	10.7	13.1	55.3	28367.0	18021.7	6408.3	-20948.5	09999	451869F04040
7	17946.7	6627.1	-21110.1	37.1	10.9	13.2	55.2	28493.8	17983.7	6453.1	-21138.7	09999	451869F04040
8	17906.9	6672.2	-21300.5	37.4	11.1	13.0	55.5	28621.8	17945.6	6497.9	-21329.3	09999	451869F04040
9	17870.3	6716.9	-21492.1	37.8	11.3	13.0	55.8	28750.7	17907.4	6542.7	-21520.3	09999	451869F04040
10	17831.0	6762.0	-21684.7	38.0	11.6	13.1	56.0	28880.7	17869.1	6587.5	-21711.7	09999	451869F04040
11	17791.6	6806.1	-21874.6	37.1	11.4	12.6	54.6	29011.8	17830.6	6632.2	-21903.5	09999	451869F04040
12	17750.9	6851.6	-22071.4	36.5	11.5	13.0	56.1	29143.8	17791.9	6676.9	-22095.8	09999	451869F04040
13	17711.3	6896.1	-22264.7	38.9	11.5	13.0	56.2	29276.8	17753.1	6721.5	-22288.6	09999	451869F04040
14	17671.8	6941.0	-22458.2	39.2	11.4	13.0	56.2	29410.8	17714.0	6766.1	-22481.7	09999	451869FC4040
15	17632.4	6986.1	-22652.1	39.4	11.5	13.1	56.2	29545.7	17674.6	6810.6	-22675.4	09999	451869F04040
16	17593.2	7031.1	-22845.6	39.7	11.3	12.9	56.3	29661.6	17634.9	6855.1	-22869.5	09999	451869F04040
17	17553.9	7076.2	-23040.9	40.0	11.3	13.2	56.3	29818.4	17594.9	6899.5	-23064.1	09999	451869F04040
18	17515.2	7120.9	-23233.6	40.2	11.4	13.1	56.4	29956.0	17554.5	6943.6	-23259.1	09999	451869F04040
19	17475.6	7166.0	-23428.0	40.4	11.5	13.0	56.5	30094.6	17513.8	6988.0	-23454.7	09999	451869F04040
20	17435.5	7210.8	-23623.9	40.9	11.8	13.0	57.1	30234.1	17472.7	7032.2	-23650.7	09999	451869F04040
21	17395.5	7255.1	-23818.4	41.0	11.8	13.0	56.9	30374.3	17431.1	7076.2	-23847.1	09999	451869F04040
22	17354.2	7300.1	-24015.7	41.7	12.2	13.2	57.9	30515.4	17389.0	7120.2	-24044.1	09999	451869F04040
23	17312.2	7344.3	-24211.7	41.5	12.4	12.9	57.5	30657.4	17346.5	7164.1	-24241.5	09999	451869F04040

4	17266.9	7388.1	-24410.0	41.6	12.8	12.7	57.7	30800.1	17303.4	7207.9	-24439.4	09999	451869F04040
5	17224.8	7431.4	-24609.0	41.9	12.8	12.6	57.8	30943.5	17259.7	7251.6	-24637.7	09999	451869F04040
6	17181.3	7475.0	-24807.8	42.1	.2.5	12.7	57.7	31067.7	17215.4	7295.2	-24836.5	09999	451869F04040
7	17137.6	7519.1	-25006.8	42.9	13.1	13.1	58.6	31232.6	17170.6	7338.7	-25035.8	09999	451869F04040
8	17092.8	7563.2	-25205.6	42.5	13.2	12.8	58.0	31378.2	17125.1	7382.1	-25235.5	09999	451869F04040
9	17047.1	7606.8	-25405.7	42.7	13.4	12.6	58.1	31524.5	17078.9	7425.4	-25435.6	09999	451869F04040
0	17000.6	7649.5	-25604.5	42.9	14.0	12.7	58.6	31671.4	17032.0	7468.5	-25636.2	09999	451869F04040

J	DG	DX	DY	DZ
1	-5.3	-47.8	169.3	17.0
2	-5.9	-45.4	170.2	20.6
3	-5.6	-43.2	171.5	22.8
4	-5.3	-41.0	172.6	24.9
5	-4.9	-39.2	173.7	26.7
6	-6.1	-37.4	174.0	29.9
7	-4.6	-37.0	174.0	28.5
8	-4.3	-36.7	174.2	28.8
9	-3.9	-37.1	174.2	28.1
0	-3.5	-38.1	174.5	27.0
1	-5.5	-39.1	173.8	28.9
2	-3.0	-41.0	174.7	24.4
3	-2.5	-41.8	174.6	23.9
4	-2.5	-42.2	174.9	23.5
5	-2.2	-42.2	175.4	23.3
6	-1.9	-41.7	176.1	23.9
7	-0.6	-41.0	176.7	23.2
8	-1.2	-39.4	177.1	25.5
9	-1.0	-38.0	178.0	26.6
0	-0.3	-37.2	178.6	26.8
1	-0.7	-35.6	178.9	28.7
2	0.3	-34.8	179.8	28.3
3	-0.2	-34.3	180.2	29.8
4	0.1	-34.4	180.2	29.3
5	0.3	-34.8	179.8	28.7
6	0.8	-34.1	179.8	28.8
7	1.6	-33.0	180.4	28.9
8	1.6	-32.3	181.1	29.8
9	2.0	-31.8	181.4	29.9
0	0.7	-31.4	181.0	31.7



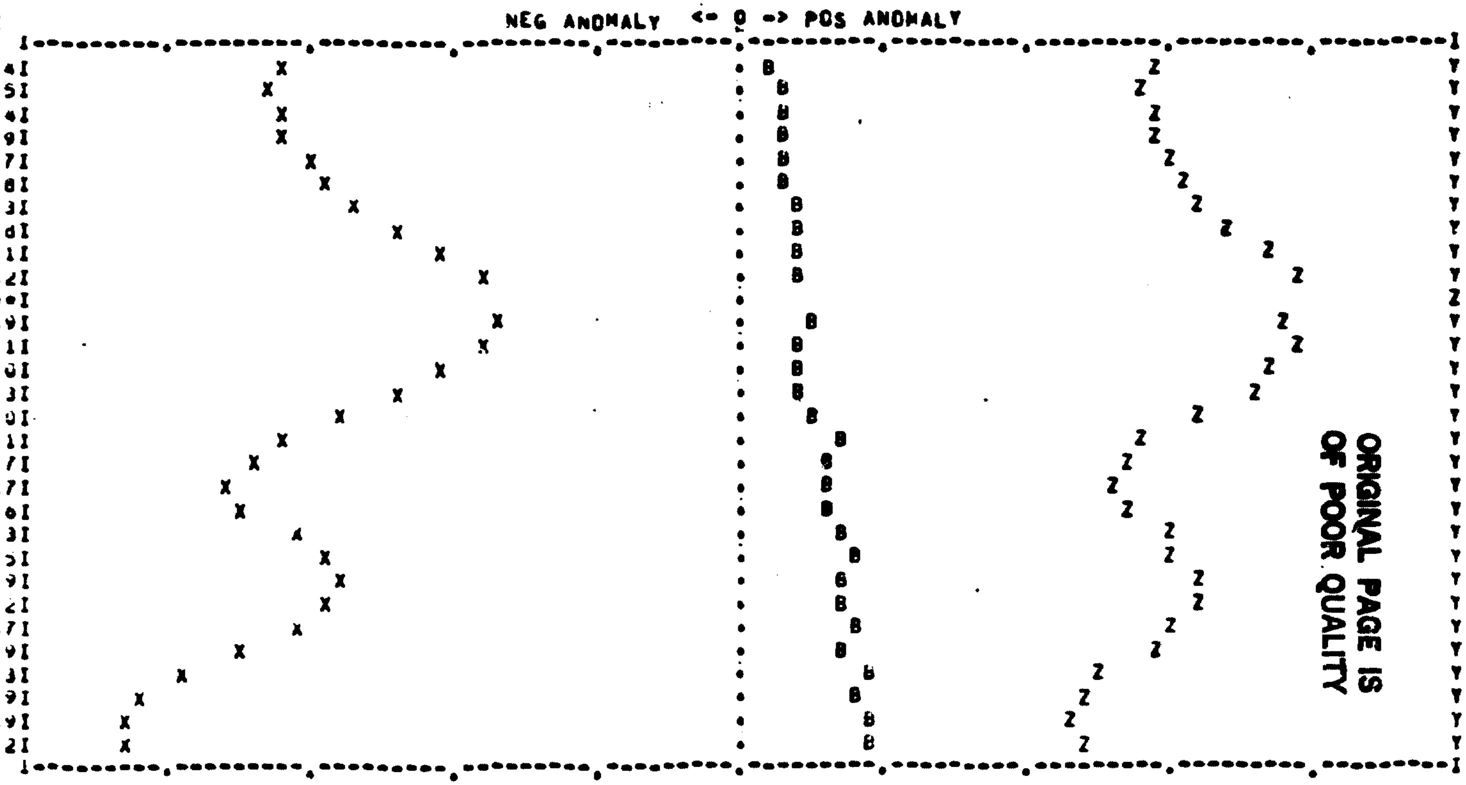
SEQ		MJD	MSEC	PASS	TINT
627	-2	44179	41462190	7	4915.4

J	LAT	LONG	RAD	MLT	INVLAT	DIPLAT	BS	BV	X	Y	Z	BVA
1	-51.1	-91.9	6873.60	5.861	41.370	-34.790	31822.7	31822.5	16952.1	7693.1	-25809.2	31821.5
2	-51.4	-92.0	6874.36	5.859	41.640	-35.039	99999.0	31971.0	16903.2	7736.8	-26010.9	31970.5
3	-51.7	-92.1	6874.91	5.857	41.902	-35.287	32119.8	32120.3	16854.8	7780.0	-26212.7	32119.0
4	-52.0	-92.2	6875.46	5.854	42.165	-35.536	32269.8	32269.9	16805.6	7823.3	-26414.3	32268.4
5	-52.4	-92.3	6876.01	5.852	42.428	-35.786	32419.9	32419.9	16755.7	7866.8	-26615.9	32418.5
6	-52.7	-92.4	6876.57	5.850	42.692	-36.036	99999.0	32570.1	16705.1	7910.3	-26817.5	32569.2
7	-53.0	-92.6	6877.11	5.848	42.957	-36.287	32721.1	32721.2	16654.7	7953.9	-27019.1	32720.9
8	-53.3	-92.7	6877.66	5.845	43.222	-36.539	32872.9	32873.4	16603.4	7997.4	-27221.9	32871.6
9	-53.6	-92.8	6878.21	5.843	43.488	-36.791	99999.0	33024.1	16551.7	8040.1	-27422.4	33023.5
10	-53.9	-92.9	6878.76	5.841	43.755	-37.043	33177.0	33177.3	16499.2	8083.9	-27625.4	33175.8
11	-54.2	-93.1	6879.30	5.838	44.022	-37.297	33329.9	99999.0	99999.0	99999.0	99999.0	99999.0
12	-54.5	-93.2	6879.84	5.836	44.291	-37.551	33483.5	33482.8	16386.4	8169.7	-28032.9	33482.4
13	-54.8	-93.3	6880.39	5.833	44.560	-37.806	99999.0	33635.6	16325.9	8209.8	-28238.7	33634.6
14	-55.1	-93.5	6880.93	5.831	44.830	-38.061	33789.9	33790.1	16263.1	8250.5	-28446.6	33788.3
15	-55.4	-93.6	6881.47	5.828	45.102	-38.317	33943.4	33943.3	16198.0	8291.1	-28653.7	33941.0
16	-55.7	-93.7	6882.01	5.826	45.374	-38.574	99999.0	34098.1	16132.2	8332.2	-28861.8	34096.6
17	-56.0	-93.9	6882.55	5.824	45.648	-38.832	34252.8	34252.4	16065.0	8372.2	-29069.8	34252.1
18	-56.3	-94.0	6883.08	5.821	45.922	-39.091	34406.9	34407.0	15997.2	8413.5	-29277.0	34405.6
19	-56.6	-94.1	6883.62	5.818	46.196	-39.350	99999.0	34561.3	15929.3	8454.5	-29483.2	34560.3
20	-56.9	-94.3	6884.15	5.816	46.472	-39.610	99999.0	34716.4	15862.5	8496.9	-29688.6	34715.1
21	-57.2	-94.4	6884.68	5.813	46.748	-39.871	34871.5	34871.2	15797.7	8540.0	-29891.6	34870.1
22	-57.5	-94.6	6885.21	5.811	47.025	-40.133	35026.8	35026.5	15730.6	8582.7	-30095.4	35026.6
23	-57.8	-94.7	6885.75	5.808	47.303	-40.396	99999.0	35180.0	15659.4	8624.7	-30300.0	35180.0
24	-58.1	-94.9	6886.27	5.805	47.581	-40.659	35336.7	35336.4	15585.6	8664.9	-30506.9	35335.2
25	-58.4	-95.0	6886.80	5.803	47.859	-40.924	35492.0	35491.6	15508.4	8705.3	-30714.2	35490.2
26	-58.7	-95.2	6887.32	5.800	48.138	-41.189	99999.0	35646.7	15429.3	8744.9	-30921.7	35644.2
27	-59.0	-95.3	6887.85	5.797	48.416	-41.455	35801.4	35801.6	15348.1	8785.0	-31129.0	35801.0
28	-59.3	-95.5	6888.37	5.794	48.695	-41.722	35956.0	35955.9	15266.1	8824.1	-31335.4	35954.8
29	-59.6	-95.7	6888.89	5.791	48.974	-41.990	36110.7	36110.8	15184.0	8863.2	-31541.8	36109.4
30	-59.9	-95.8	6889.42	5.789	49.254	-42.258	99999.0	36265.1	15102.4	8904.6	-31745.6	36263.8

J	XA	YA	ZA	BVSD	XSD	YSD	ZSD	BMD	XMJ	YMD	ZMD	QUAL	SPARE
1	16952.4	7693.2	-25807.8	43.0	14.1	12.5	58.6	31819.0	16984.3	7511.6	-25837.2	09999	451869F04040
2	16903.7	7736.4	-26010.1	43.6	14.3	12.8	59.1	31967.2	16935.9	7554.5	-26038.5	09999	451869F04040
3	16855.0	7779.8	-26210.9	43.4	14.3	12.6	58.6	32115.9	16886.7	7597.3	-26240.3	09999	451869F04040
4	16805.5	7823.1	-26412.6	43.6	14.3	12.5	58.6	32265.2	16836.6	7640.0	-26442.5	09999	451869F04040
5	16755.8	7866.5	-26614.3	43.7	14.6	12.7	58.6	32415.1	16785.7	7682.6	-26645.0	09999	451869F04040
6	16705.7	7909.9	-26816.1	43.8	14.7	12.7	58.6	32565.5	16733.9	7725.0	-26847.9	09999	451869F04040
7	16654.6	7953.4	-27018.9	44.2	15.1	12.6	59.1	32716.3	16681.1	7767.4	-27051.1	09999	451869F04040
8	16603.4	7996.7	-27219.8	44.1	14.8	12.7	58.6	32867.5	16627.4	7809.5	-27254.7	09999	451869F04040
9	16552.1	8040.4	-27421.4	44.2	15.1	12.8	58.6	33019.3	16572.8	7851.6	-27458.5	09999	451869F04040
10	16499.2	8083.9	-27623.5	44.3	15.7	12.6	58.9	33171.4	16517.0	7893.5	-27662.7	09999	451869F04040
11	99999.0	99999.0	99999.0	99999.0	99999.0	99999.0	99999.0	33323.9	16460.3	7935.3	-27867.0	09999	451869F04040
12	16386.0	8169.1	-28032.7	44.6	17.0	12.0	59.7	33476.7	16402.4	7976.9	-28071.6	09999	451869F04040
13	16326.0	8209.7	-28237.3	44.6	17.9	11.9	60.0	33629.8	16343.5	8018.5	-28276.4	09999	451869F04040
14	16263.0	8250.4	-28444.5	44.7	18.6	11.8	60.3	33783.3	16283.4	8059.9	-28481.6	09999	451869F04040
15	16196.6	8290.7	-28650.5	44.7	19.3	11.8	60.4	33937.0	16222.2	8101.1	-28686.8	09999	451869F04040
16	16132.3	8331.7	-28860.1	44.8	19.4	11.8	60.4	34090.9	16159.8	8142.2	-28892.1	09999	451869F04040
17	16064.5	8372.5	-29069.5	44.9	19.6	11.9	60.3	34245.0	16096.1	8183.2	-29097.6	09999	451869F04040
18	15997.3	8413.1	-29275.5	45.0	19.7	12.0	60.2	34399.3	16031.2	8224.1	-29303.2	09999	451869F04040
19	15929.3	8454.4	-29482.2	45.0	19.8	12.1	59.9	34553.8	15965.0	8264.8	-29508.9	09999	451869F04040
20	15862.6	8496.6	-29687.4	45.0	18.9	12.5	59.1	34708.4	15897.8	8305.3	-29714.6	09999	451869F04040
21	15797.9	8539.8	-29890.2	45.0	18.8	12.6	58.9	34863.1	15828.8	8345.8	-29920.4	09999	451869F04040
22	15730.4	8582.9	-30095.7	44.4	20.1	12.0	58.8	35017.8	15758.6	8386.1	-30126.2	09999	451869F04040
23	15659.8	8624.1	-30299.0	45.0	21.2	12.0	59.8	35172.6	15687.0	8426.3	-30331.9	09999	451869F04040

24	15585.7	8664.9	-30505.3	45.0	22.0	11.8	60.0	35327.3	15614.1	8466.3	-30537.6	09999	451869F04040
25	15508.9	8705.1	-30712.4	45.0	22.9	11.6	60.3	35482.1	15539.6	8506.3	-30743.2	09999	451869F04040
26	15429.7	8744.7	-30918.7	44.5	23.0	11.3	59.5	35636.8	15463.8	8546.1	-30948.6	09999	451869F04040
27	15347.9	8784.5	-31128.5	44.3	23.4	11.3	59.3	35791.4	15386.4	8585.7	-31153.9	09999	451869F04040
28	15266.5	8823.5	-31334.0	44.9	23.9	11.5	60.0	35945.8	15307.5	8625.3	-31358.9	09999	451869F04040
29	15184.3	8863.2	-31539.9	44.9	23.8	11.7	59.6	36100.1	15227.1	8664.7	-31563.8	09999	451869F04040
30	15102.6	8903.8	-31744.2	44.9	23.8	11.8	59.2	36254.2	15145.2	8704.0	-31768.4	09999	451869F04040

J	DB	DX	DY	DZ
1	2.5	-32.0	181.6	29.4
2	3.3	-32.2	181.9	28.5
3	3.1	-31.7	182.5	29.4
4	3.2	-31.1	183.0	29.9
5	3.4	-29.9	183.9	30.7
6	3.7	-28.2	184.9	31.8
7	4.6	-26.5	186.0	32.3
8	4.1	-24.0	187.2	34.8
9	4.3	-20.7	188.8	37.1
10	4.4	-17.8	190.4	39.2
11	66675.1	63538.7	92063.7	*******
12	5.8	-16.5	192.1	38.9
13	4.8	-17.5	191.3	39.1
14	5.0	-20.5	190.6	37.0
15	4.0	-23.4	189.6	36.3
16	5.7	-27.5	189.4	32.0
17	7.0	-31.6	189.3	28.1
18	6.3	-34.0	189.1	27.7
19	6.5	-35.7	189.6	26.7
20	6.8	-34.9	191.3	27.6
21	7.0	-30.9	194.0	30.3
22	8.6	-28.2	196.5	30.5
23	7.4	-27.2	197.9	32.9
24	7.6	-26.4	198.6	32.2
25	8.1	-30.8	198.8	30.7
26	7.4	-34.1	198.6	29.9
27	9.7	-38.5	198.8	25.3
28	9.0	-41.0	198.2	24.9
29	9.3	-42.8	198.5	23.9
30	9.6	-42.6	199.8	24.2



ORIGINAL PAGE IS OF POOR QUALITY

APPENDIX B

CRUSTAL STRUCTURE OF SOUTHEASTERN MINAS GERAIS, BRAZIL, DEDUCED FROM GRAVITY MEASUREMENTS

D. BLITZKOW [1]
P. GASPARINI [2]
N.C. DE SÁ [4]

[1,2,3,4] INSTITUTO ASTRONÔMICO E GEOFÍSICO — UNIVERSIDADE DE SÃO PAULO — CAIXA POSTAL 30.627 — 01000 — SÃO PAULO — BRAZIL

M.S.M. MANTOVANI [3]

[2] ON LEAVE OF ABSENCE FROM: INSTITUTO DI GEOLOGIA E GEOFÍSICA — UNIVERSITY OF NAPOLI — ITALY

ABSTRACT

A gravity survey was carried out in the State of Minas Gerais, between 18° and 20°S, 42° and 44°30' W, utilizing the FIBGE topographic network. These first order data were integrated with other stations where the altitude was measured by barometric methods. The survey was made along profiles with the aim of extending the crustal informations obtained by an unreversed refraction seismic profile. Bouguer anomalies were inverted by computer techniques which make use of two-dimensional models of arbitrary shape and fitting with experimental data by iterative methods.

A normal depth of 38-40 km was obtained for the Moho in the area. A crustal thickening was observed between Itabira and Guanhães where the Moho reaches a depth of 45 km.

A lower crustal layer of intermediate density is required from gravity data.

RESUMO

Foi efetuado um levantamento gravimétrico no Estado de Minas Gerais, entre 18° e 20°S, 42° e 44°33' W, sobre a rede de nivelamento geométrico da FIBGE. Nos intervalos onde não foram encontradas RNs as altitudes foram determinadas por nivelamento barométrico. O levantamento gravimétrico foi conduzido ao longo de perfis e tem o objetivo de estender as informações sobre a estrutura crustal, obtidas através de uma prospecção sísmica a refração não revertida. A inversão das anomalias de Bouguer foi efetuada com técnicas de computação utilizando modelos bi-dimensionais de forma qualquer e ajuste aos dados experimentais por métodos iterativos. Foi obtida uma profundidade normal de 38-40 km para a MOHO.

Entre Itabira e Guanhães, foi observada uma espessura crustal maior e a MOHO se encontra a uma profundidade de 45 km.

Os dados gravimétricos implicam na existência de uma camada com densidade intermediária na crosta inferior.

INTRODUCTION

Gravity data processed by modern techniques proved to be very useful in preliminary investigations of the main crustal featurs and the crust-upper mantle transitions in different structural environments. In many cases they furnished low cost preliminary crustal models, which were afterwards checked and detailed by more sophisticated and expensive techniques, such as deep seismic soundings (DSS). They have been used also as a methodology complementary to DSS to extend to a larger area the crustal informations obtained along single DSS profiles.

Successful gravity derived crustal models exist in oceanic areas (e.g. Talwani et al., 1965), island arcs (e.g. Makris, 1976), young orogens (e.g. Morelli, 1973; Corrado et al., 1974), pre-Cambrian areas (e.g. Ramberg, 1973).

Quantitative estimates of the crustal thickness in the Brazilian territory are quite scanty at present.

The aim of this paper is to construct a gravity derived preliminary crustal model in the southeastern part of the Minas Gerais State (between 18° and 20°S, 42 and 44°30' W), complementing and extending the informations furnished by the only DSS profile up to now existing in that area. This is a 180 km long unreversed profile which was carried out between Itabira and São João Evangelista by a German group directed by P. Giese, under the sponsorship of the Brazil-Germany agreement for scientific cooperation (Giese, 1975).

GEOLOGICAL OUTLINE

The surveyed area includes the south-western margin of the São Francisco craton and the neighbouring metamorphic-sedimentary belt formed during the Brazilian cycle (Almeida, 1977), i.e. the latest orogenic cycle which affected a large part of South American in late pre-Cambrian and Eo-Cambrian times (about 600-650 m.y.) (Cordani et al., 1973).

A very simplified geological sketch map is reported in Fig. 1 High grade metamorphic terrains of granulite and amphibolite facies and kinzigitic gneisses are largely predominant. These formations are of Archean (2,000-2,600 m.y.) and pre-Cambrian (1,000-1,400 m.y.) ages and constitute the oldest outcropping rocks. A pre-Cambrian metasedimentary cover (Espinhaço formation) overlies these rocks in a N-striking region which is located N of Quadrilatero Ferrifero. A N-trending reverse fault terminates the Espinhaço formation to the West, where it contacts cabonatitic rocks and metasediments belonging to the Brazilian cycle.

The intermixing of rocks of different metamorphic grade and chemical composition does not allow a reliable estimate of local densities to be used for Bouguer correction in the areas where the basement crops out. A slightly lower density might be used for the stations located on the Espinhaço formation and on Brazilian cycle terrains because in principle the sedimentary cover should have a lower density than the basement, however, as the sediments are generally metamorphosed and its thickness is unknown, it has been preferred to use the same density for the whole area in order to avoid contamination of the results by uncontrolled assumptions. Hence, the average density usually assumed for the upper crust (2.67 $g.cm^{-3}$) has been used for the Bouguer corrections. No correlation between Bouguer anomalies and altitude has been found, even for stations located on the sedimentary cover. This indicates that the chosen density is a reasonable one.

THE GRAVITY SURVEY

About 300 gravity measurements were made in an area of 50,000 km^2. Taking into account the transitability of the region and the aim of the survey, a distribution of the measurement stations along profiles was preferred to a regular network. A distribution along profiles perpendicular to the main geological estructures is particularly suitable for inverting the data by computer techniques which make use of twodimensional models. Three almost parallel NE trending profiles were chosen, as they area approximately perpendicular to the main geological trends (from Curvelo to Couto de Magalhães, from Belo Horizonte to São João Evangelista, from Barão de Cocais to Governador Valadares). Three transversal profiles (from Curvelo to Sabará, from Datas to Guanhães, from São João Evangelista to Governador Valadares) were also carried out. As the aim of the survey was not the investigation of shallow structures a spacing of 5 km between the stations was considered adequate

The gravity was measured by a Worden, Master type, and two La Coste and Romberg, Model G, gravity meters. The measured values were referred to the base station of Pampulha Airport (Belo Horizonte), for which the IGSN value of:

$$g = 978.38550 \text{ gal}$$

was used. Gravity values measured by Observatório Nacional (Rio de Janeiro) (Gama, 1972) were also included in the construction of the Bouguer anomaly map (Fig. 1) and the profiles (Fig. 3). These data were also reduced to the IGSN system by connecting some of the Observatório Nacional stations to the Pampulha Airport base station.

The gravity measurements were made on the FIBGE benchmarks available in the region. Further gravity measurements were made on stations where the altitude was determined barometrically by System Pauling altimeters of Instituto de Geociências of USP, by carrying out short circuits closed on FIBGE benchmarks. The accuracy of barometric determinations of altitude is estimated to be better than + 5m, leading therefore to an overall uncertainity not higher than 1.0 mgal in the Bougher anomalies.

Faye and Bouguer corrections were applied to the measured data. A density of 2.67 $g.cm^{-3}$ was used for the Bouguer correction (see discussion in the former section). Topographic corrections were not applied due to the lack of suitable topographic maps. Hovewer station points were chosen generally in such a way as to ensure that topographic effects were not higher than some tenths of a milligal as far as zone E of the Hayford scheme (560 m.). Topographic irregularities existing at longer distances are not as prominent as to produce effects higher than 0.2 mgal.

Bouguer anomalies were computed with respect to the 1967 gravity reference field. The accuracy of the Bouguer anomaly for each station is estimated to be 1.0 mgal, which is largely sufficient for the aim of the present paper.

The location of all gravity stations is reported in Fig. 1, where open circles indicate IBGE benchmarks, filled circles indicate stations where the altitude was determined barometrically and triangles indicate the stations measured by Observatório Nacional. A Bouguer map was elaborated (Fig. 1). A listing of coordinates, observed gravity and reduction values for all the stations is available at Instituto Astronômico e Geofísico, USP.

THE BOUGUER ANOMALY MAP

The prominent feature of the gravity field in the area is a large low of about -50 mgal, which is located between Itabira and Guanhães and is elongated in the same direction as the main geological structures (NNW). The extension of this anomaly indicates that its source must be very deep and it is likely that it is related to the crustupper mantle transition. The center of the anomaly is located in the area where kinzingitic gneisses and amphibolitic facies rocks of the pre-Cambrian Barbacena formation are dominant.

The pattern of the Bouguer anomalies in the surveyed area is quite regular. The only evidences of important discontinuities in the upper crustal layers are a high of about + 30 mgal located SW of Serro and two lows, one located at the western margin of the surveyed area and the other between Governador Valadares and São João Evangelista.

The steepening of the gravity gradient where the profiles C-C' and A-A' cross the contact between the EoCambrian São Francisco supergroup formations and the Espinhaço formations (Fig. 2) indicates the existence of a major tectonic discontinuity. The occurrence of a similar gradient around Itabira suggests that this tectonic line continues Southeastward, affecting also the area where the basement crops out.

The data reported in Fig. 1 were used for a quantitative evaluation of the depth of the Moho discontinuity and any other possible intracrustal layer.

CRUSTAL MODELS

The Bouguer anomalies calculated along the profiles A-A', B-B', C-C' and D-D' (see Fig. 1) were smoothed to eliminate the effects of sources lo-

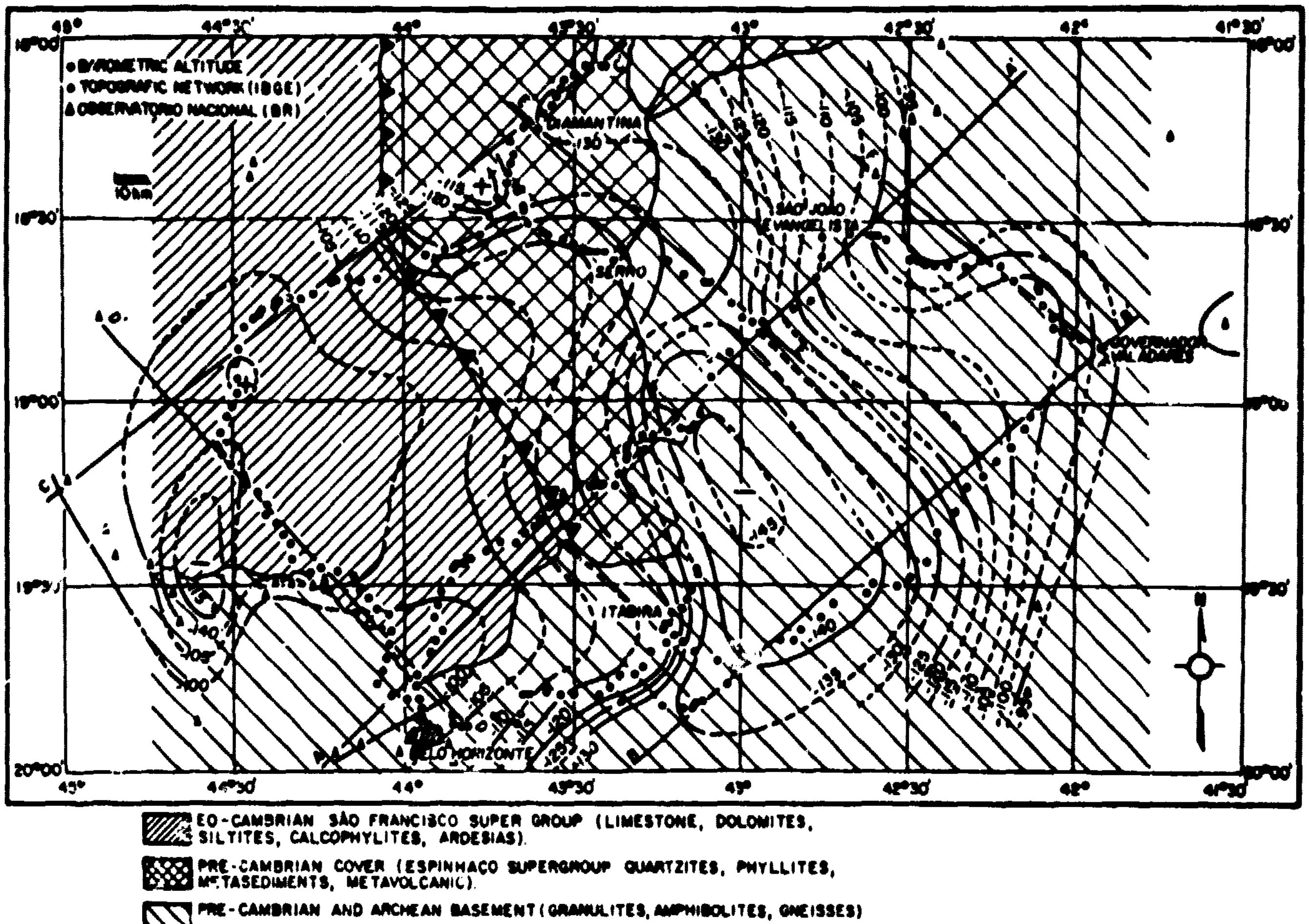


Fig. 1 — Bouguer anomaly map and simplified geological sketh. Contour lines Interval: 5 mgal.

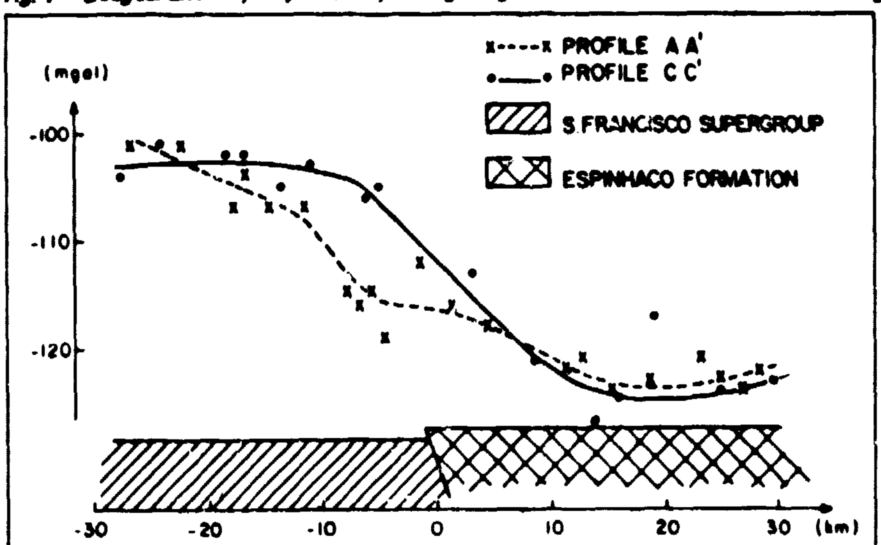


Fig. 2 — Bouguer anomaly profiles through the contact between San Francisco supergroup and Espinhaço formation.

cated within the few uppermost km of crust. The obtained profiles were then inverted by the computer technique described by Carrara et al. (1974). It consists of the utilization of a two-dimensional model of arbitrary poligonal cross section and assigned density contrast. At first,, the gravity field produced by the poligonal body the Taylor expansion relative to the variable z (depth), limited to the terms of 1st order. Then the computed gravity is compared with the observed gravity by interative procedures, which make use of a least square method. The best fit relative to the chosen model is so obtained. Given the ambiguity inherent to gravity contrasts are not well known it is convenient that at least the depth of the body be determined by other geophysical methods at some point along the profile, if a reliable solution is desired.

The only additional geophysical data existing in the area, which could help in defining the initial model to be used in the computations, are the P-wave velocity functions obtained by the DSS unreversed profile (Giese, 1975). Two main P-wave groups were recorded along this profile. A wave-group with apparent velocities of 6.2 km/sec was recorded as firts arrivals as far as the end of the profile (180 km from the shotpoints). A second group had apparent velocity around 8 km/sec. The long distance through which the first wave group is recorded as first arrivals indicates that the crust must have constant velocity down to 25-30 km. No wave groups were observed which may indicate a first order discontinuity within the crust. The analysis of the second wave group and the lack of clear phases reflected from the Moho discontinuity suggest that the transition from a velocity around 6.2 km/sec to velocities typical of the upper mantle must be continuous and no sharp Moho discontinuity exists. The depth where upper

at 42 km. Therefore the lowest 14 km of crust must be characterized by P-wave velocities gradually increasing with depth.

4%. Therefore the apparent P-wave velocities should be quite close to the real velocities. The crustal thickening occurs in a 80-100 km wide NNW

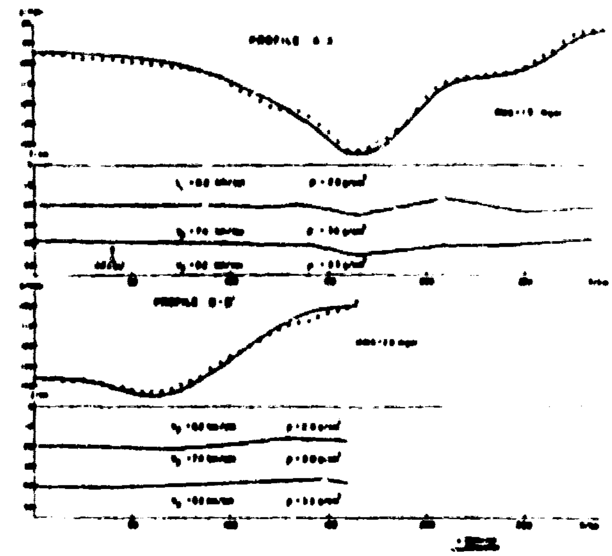


Fig. 3a — Computed crustal models along profiles AA' and BB'. Observed values are compared with curves calculated from the model.

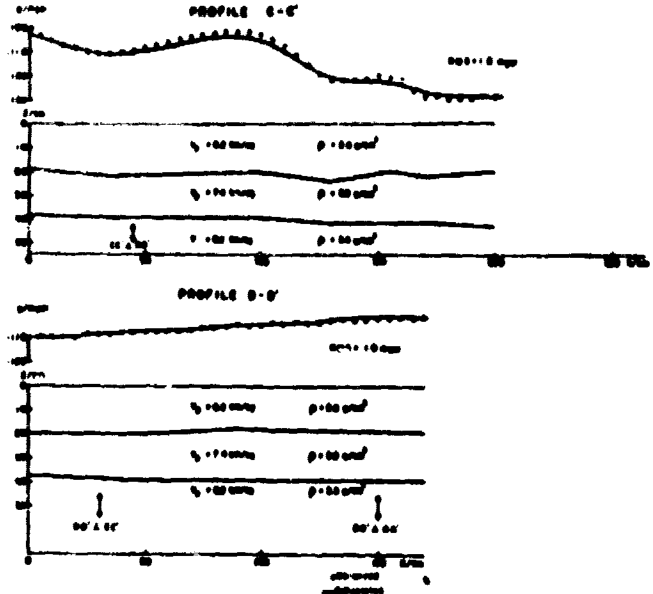


Fig. 3b — Computed crustal model along profiles CC' and DD'. Observed values are compared with curves calculated from the model.

The DSS profile coincides with the northermost part of the A-A' profile (from Guanhães to São João Evangelista). The crustal model used to invert gravity data is represented in Fig. 3. It was constrained to a crustal thickness of 42 km at Guanhães. The chosen densities are consistent with similar models in other pre-Cambrian areas (e.g. Ramberg, 1973) and with the densities which can be estimated from apparent P-wave velocities applying the well-known Nafe and Drake relationship. Of course the assumption of a well defined lower crustal layer is a schematization of the gradually changing layer suggested by DSS data. The density of 3.0 g.cm^{-3} is consistent with the average velocity of 7.4 km/sec suggested by Giese (1975). The successful models and the computed profiles are reported in Fig. 3a, and b. Standard deviations between computed and observed values are lower than $\pm$ 2.0 mgal for all the profiles. It must pointed or that the observed data are not compatible with any reliable two-layers model, that is the existence of a lower crustal layer of intermediate density is required to have a good fit with the observed data. The satisfactory fit of the computed with the observed gravity indicates that the low existing between Itabira and Guanhães is to be ascribed partly to a deepening of the Moho and partly to a deepening of the top of the lower crustal layer. The crust reaches a maximum thickness of 45 km in this area, whereas the normal depth all around is 38-40 km. The inclination of the Moho along the seismic profile is not higher than 3-

elongated area and it must be related with the compressional tectonic boundary between the Eocambrian São Francisco supergroup and the Espinhaço formations. The highest crustal thickening occurs where medium and high grade metamorphic rocks of the Barbacena formation outcrop. The crustal thickening represents probably the remnant of an isostatically adjusted pre-Cambrian mountain root. The constant P-wave velocity and the gravity derived model consistently indicate constant physical characteristics of the crust down to 25-30 km of depth. No major variations of metamorphic grade and/or chemical composition are therefore likely in this depth interval. The normal thickness and the general characteristics of the crust in the surveyed area are close to those observed in other pre-Cambrian areas, such as Canada (Wynne- Edwards, 1972) and Southern Norway (Kanestrøm, 1977).

The lower crustal layer required from the gravity data begins from a depth of 20 to 27 km, according to the schematized model. This layer may be formed by rocks of mafic nature. This inference is supported by the analysis of the long wavelength crustal anomalies of the magnetic field which suggest the existence of a compositional variation toward mafic terms at depth of 22 - 27 km. (Corrado et al., in press).

CONCLUSIONS

The inversion of the gravity data by a two dimensional model of arbitrary shape indicates that:

a) the normal crustal thickness in the surveyed area is 38-40 km;

b) a zone of crustal thickening exists between Itabira and Guanhães. It is a 80-100 km wide NNW trending strip where the crust reaches a thickness of 45 km. The occurrence of a thicker crust in this area is consistent with the existence of a compressional front between the São Francisco supergroup and the Espinhaço formations.

c) the existence of a lower crust of intemediate density is required from gravity data. DSS data suggest however that no first order discontinuity exists within the crust, and that the elastic characteristics of the rocks constituting the lowermost crust approach gradually upper mantle values. If this situation can be schematized by assuming the existence of a lower crustal layer with density of 3.0 g/cm^3, the depth of the top of this layer is normally at 20 km, increasing to 27 km in the zone of crustal thickening. Greater depths can be computed for the top of this layer if higher densities are assumed.

ACKNOWLEDGEMENTS

The authors are grateful to Prof. Camil Gemael, coordinator of the Graduation Course in Geodesy at the University of Paraná (Curitiba), who furnished the Worden gravity meter used in this research. The Pauling System altimeters were provided by the Instituto de Geociências, University of S. Paulo, G. Corrado and A. Rapolla, Instituto di Geologia e Geofisica, University of Napoli,